BUYER'S GUIDE

PASSENGER ELEVATORS

WESTINGHOUSE

ELEVATOR DIVISION

The information contained in this publication has been prepared to serve as a guide to those concerned with the efficient transportation of passengers in office buildings, hotels, stores, apartment houses, hospitals, banks, and industrial plants. This information will assist architects, consulting engineers, and building management in the preparation of their plans for passenger elevators.

Copies of the following Westinghouse publications may be obtained by writing on your letterhead to Westinghouse Electric Corporation, Elevator Division, Jersey City 4, New Jersey.

BUYER'S GUIDE, *FREIGHT ELEVATORS* (B-4402) • BUYER'S GUIDE, *ELECTRIC STAIRWAYS* (B-4582) WESTINGHOUSE BALANCED *VERTICAL TRANSPORTATION* (B-4586) • WIDENING FIELD OF *MOVING STAIRWAYS* (B-5265) • WESTINGHOUSE SELECTOMATIC (B-5274)

Neville

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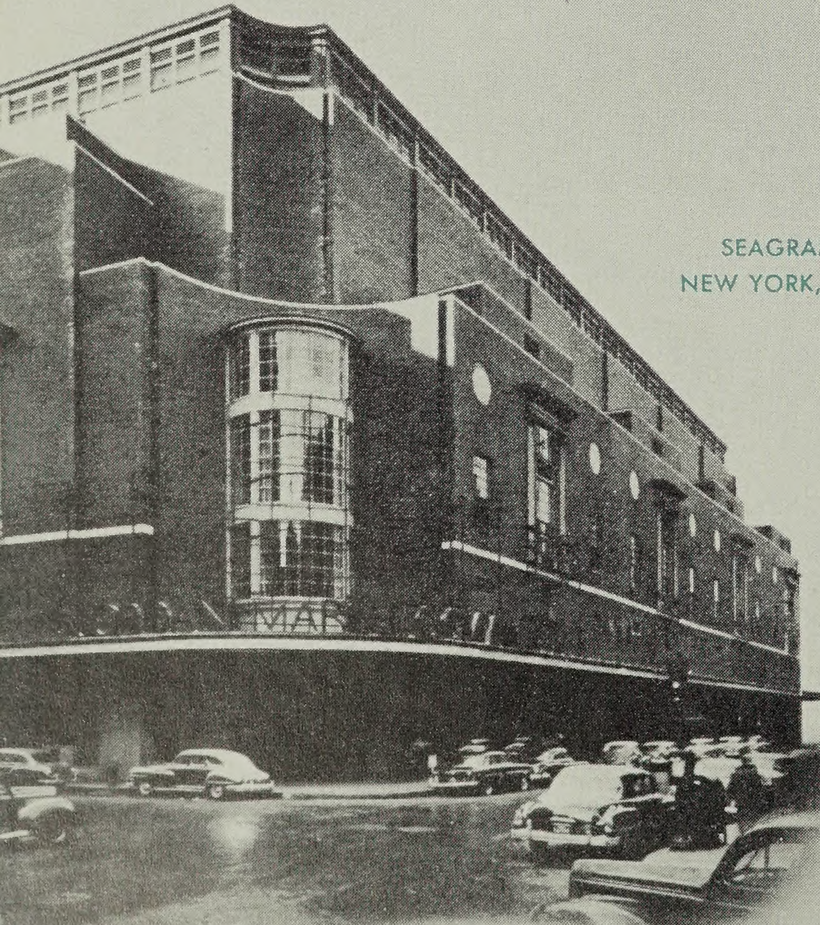
ELEVATOR DIVISION
Westinghouse Electric Corporation
Jersey City 4, New Jersey

Typical

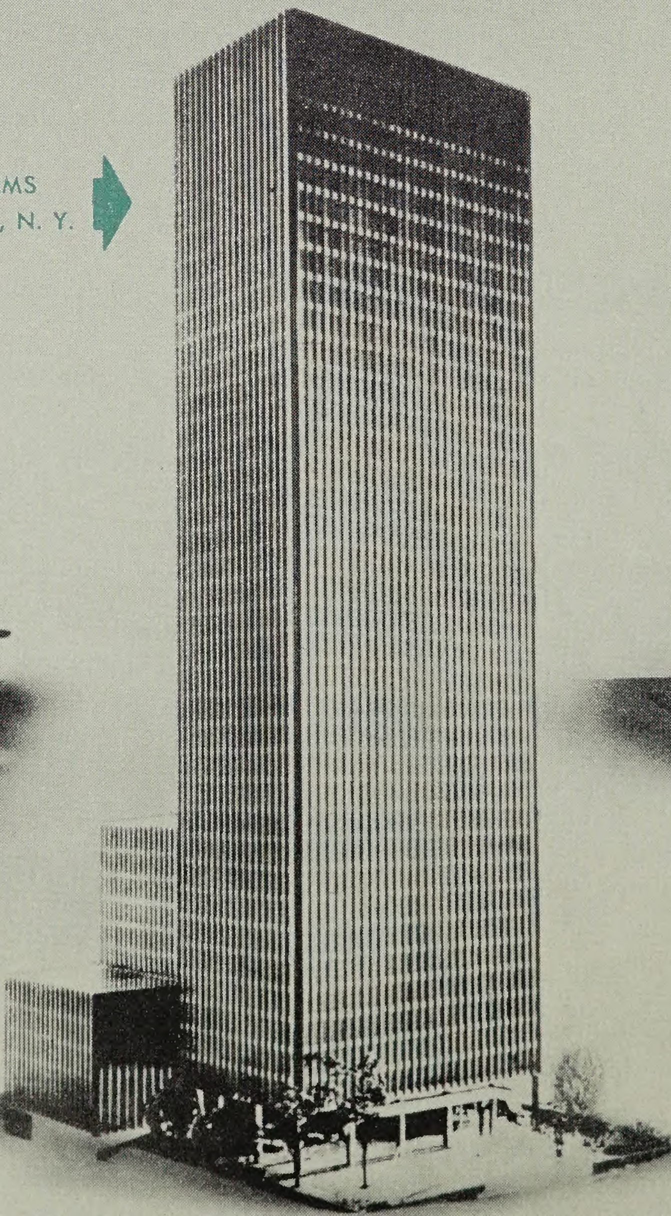
ALUMINUM COMPANY
OF AMERICA
PITTSBURGH, PENNA.

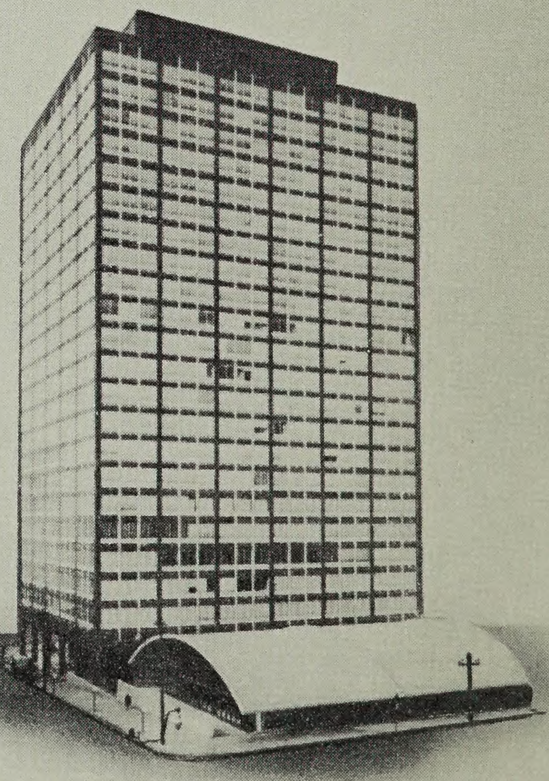
EDEN ROC
HOTEL, CABANA AND YACHT CLUB
MIAMI, FLA.



JORDAN MARSH DEPT. STORE
BOSTON, MASS.

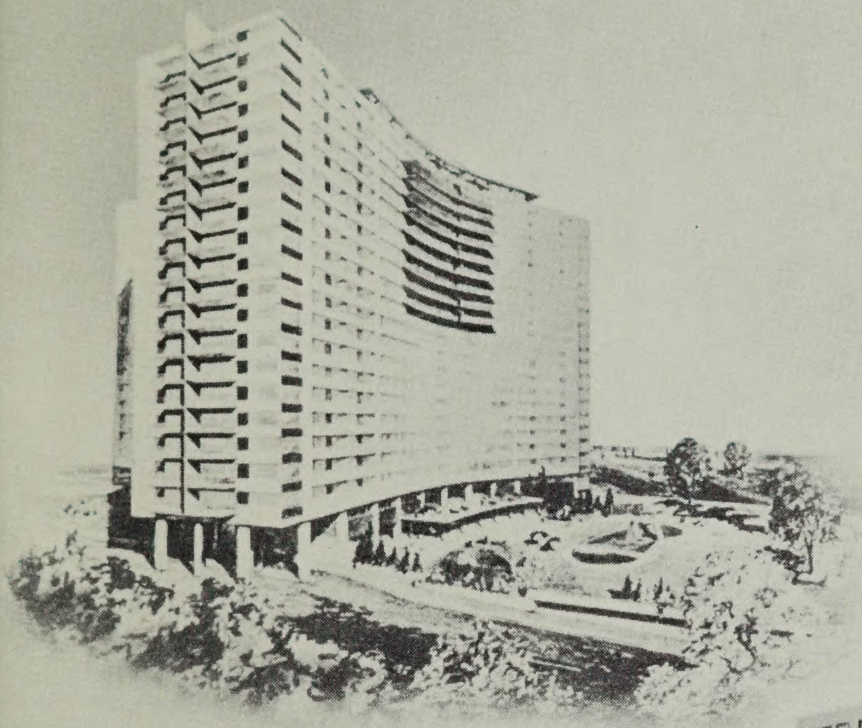
SEAGRAMS
NEW YORK, N. Y.





MILE HIGH CENTER
DENVER, COLO.

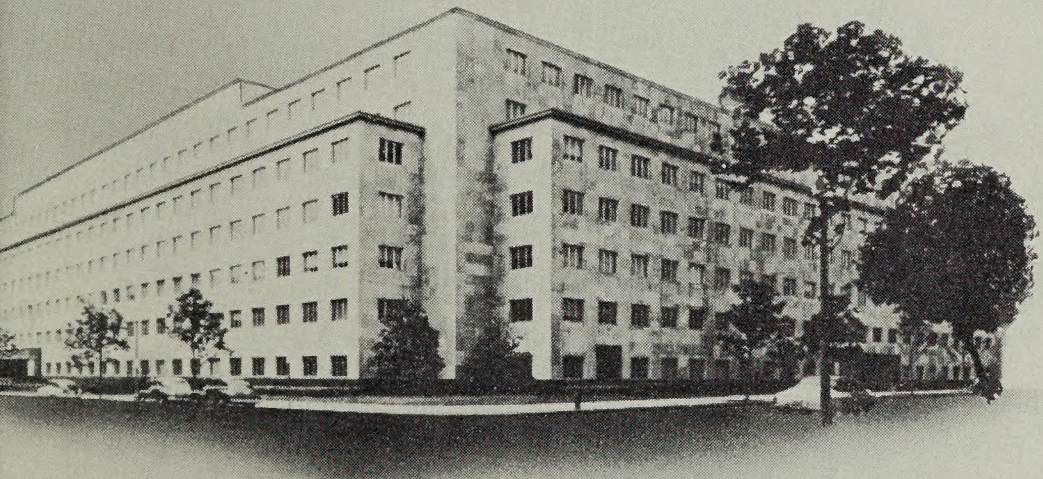
WESTINGHOUSE ELEVATOR INSTALLATIONS



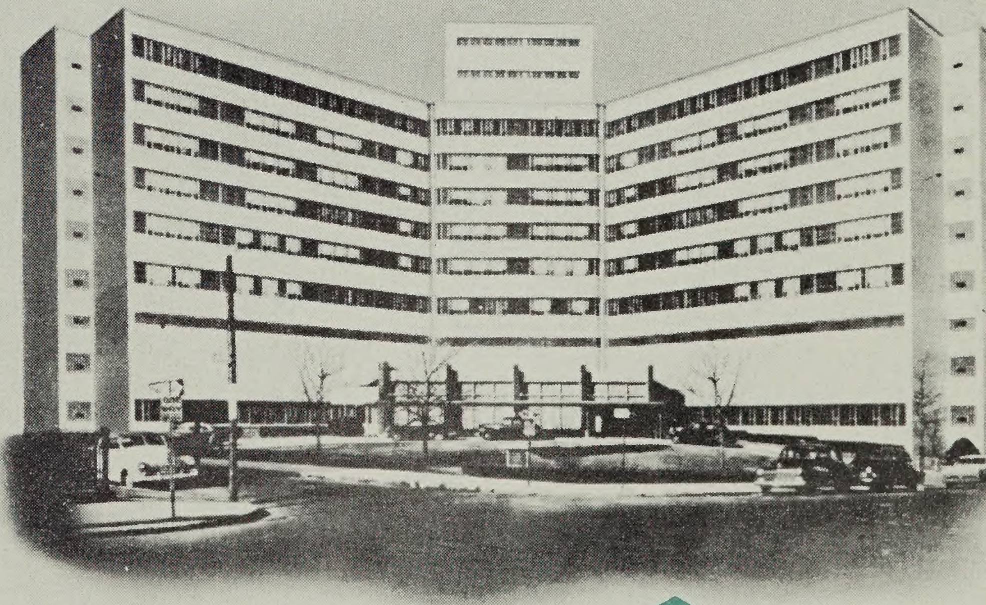
HARRISON PARK APTS.
EAST ORANGE, N. J.

EQUITABLE LIFE
INSURANCE
SAN FRANCISCO
CALIFORNIA

BANK OF THE SOUTHWEST
HOUSTON, TEXAS

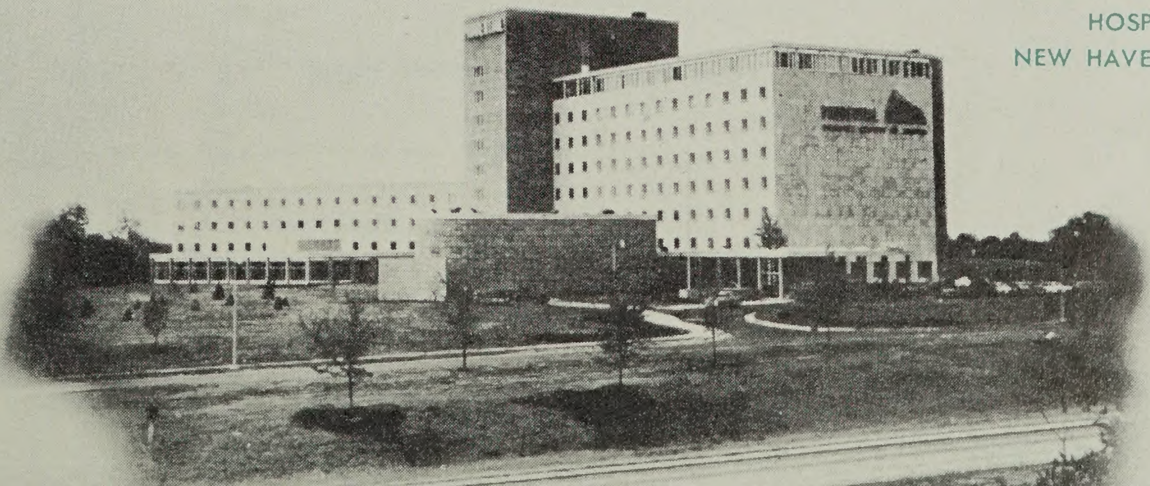


GENERAL ACCOUNTING OFFICE
WASHINGTON, D. C.



GRACE NEW HAVEN
HOSPITAL
NEW HAVEN, CONN.

PRUDENTIAL INSURANCE
COMPANY OF AMERICA
MINNEAPOLIS, MINN.



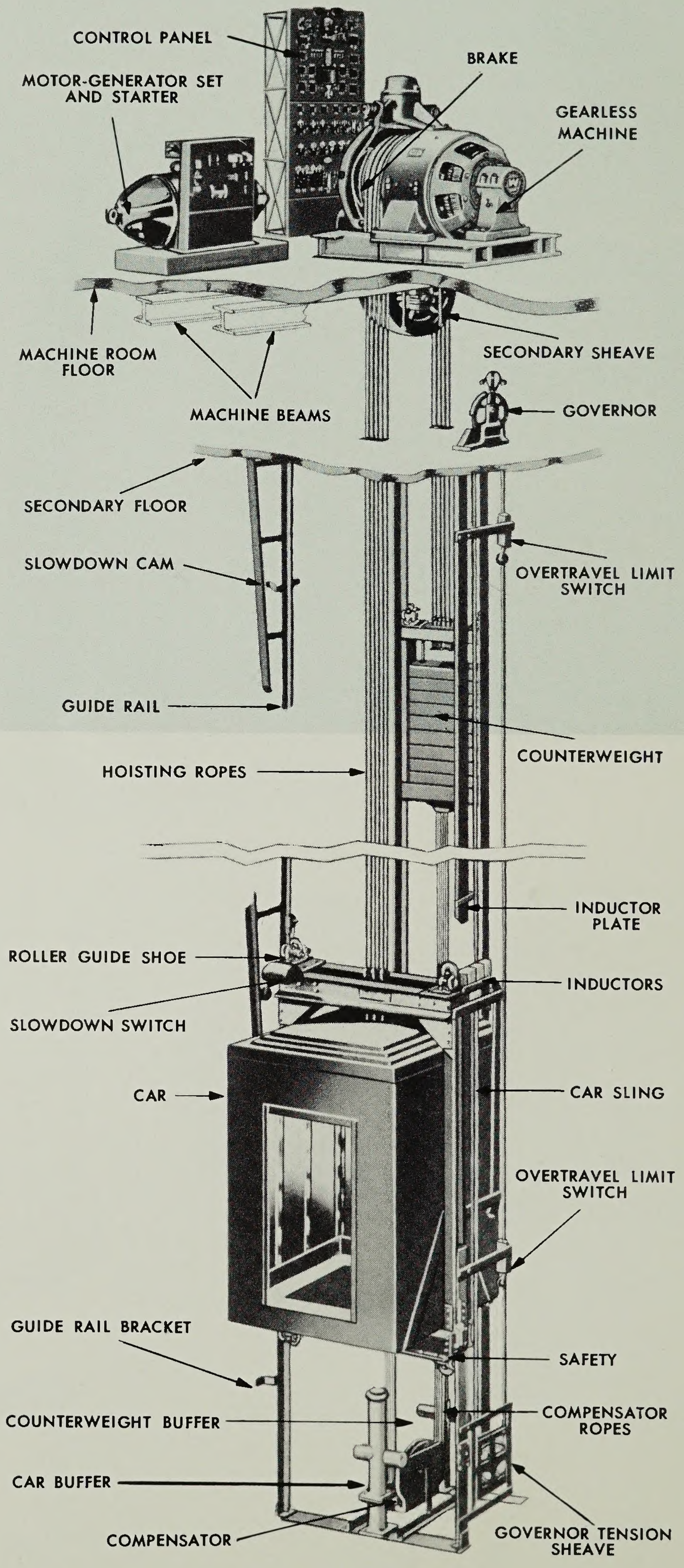


Figure 1. Typical Gearless Variable Voltage Traction Passenger Elevator

Introduction

GENERAL *(figure 1)*

Today, twenty-five times as many passengers are carried by elevators in the United States each year as are transported by all our railroads combined. Annually, more than 50,000,000,000 passengers are carried a total of 200,000,000 miles in the 225,000 elevators in this country. These figures clearly prove that the very existence of large buildings depends upon vertical transportation, since without it floors above the second would have very little value. Elevators are therefore a major item in the planning or modernization of a building where vertical transportation is required.

The engineering, manufacture, and installation of Westinghouse passenger elevators are determined by considerations of safety, economy, reliability, efficiency, and appearance.

SELECTING THE PROPER PASSENGER ELEVATORS

Even though today's passenger elevators have been standardized into four general classifications—general-purpose, department store, apartment house and hospital—the selection of the proper passenger elevators nevertheless depends upon a careful analysis of the density and distribution of the building population, the number of floors to be served, and the location and type of building. Only in this way can the number, size, and type of elevators best suited be determined.

> **NOTE:** General-purpose elevators are applicable to office buildings, hotels, and industrial buildings.

Component Parts

A. GENERAL

All modern passenger elevators are the traction type, incorporating multiple hoist ropes which pass over a driving sheave on the machine. Roping is usually of the 1:1 type, although the 2:1 type is standard for some speeds *(figure 2).*

B. BASIC CONTROL SYSTEMS

The elevator control system may be either Rheostatic or Variable Voltage.

1. The rheostatic system, which is confined to low-speed elevators, applies the electric power supplied to the building directly to the elevator motor.

2. The variable voltage system includes a motor-generator set for each elevator. The speed of the elevator is controlled by varying the field of the d-c generator which in turn varies the voltage impressed on the d-c elevator motor. All gearless elevators and most geared elevators operating at more than 100 feet per minute make use of the variable voltage system.

C. GEARLESS MACHINE *(figure 3)*

The Westinghouse gearless machine is a specially designed d-c electric motor with a brake wheel and a traction sheave mounted directly on the armature shaft.

This machine is used with elevators having speeds in excess of 350 feet per minute.

D. GEARED MACHINE *(figure 4)*

The Westinghouse geared machine consists of a worm, a gear, a sheave mounted on Timken bearings, a brake, and a flange-mounted motor—all accurately and rigidly assembled into a single unit.

The unit frame design allows correct alignment and minimizes the chances of deflection during shipment and installation. The flange-mounted motor provides a particularly rigid connection between the motor and the machine resulting in minimum noise and wear and increased efficiency.

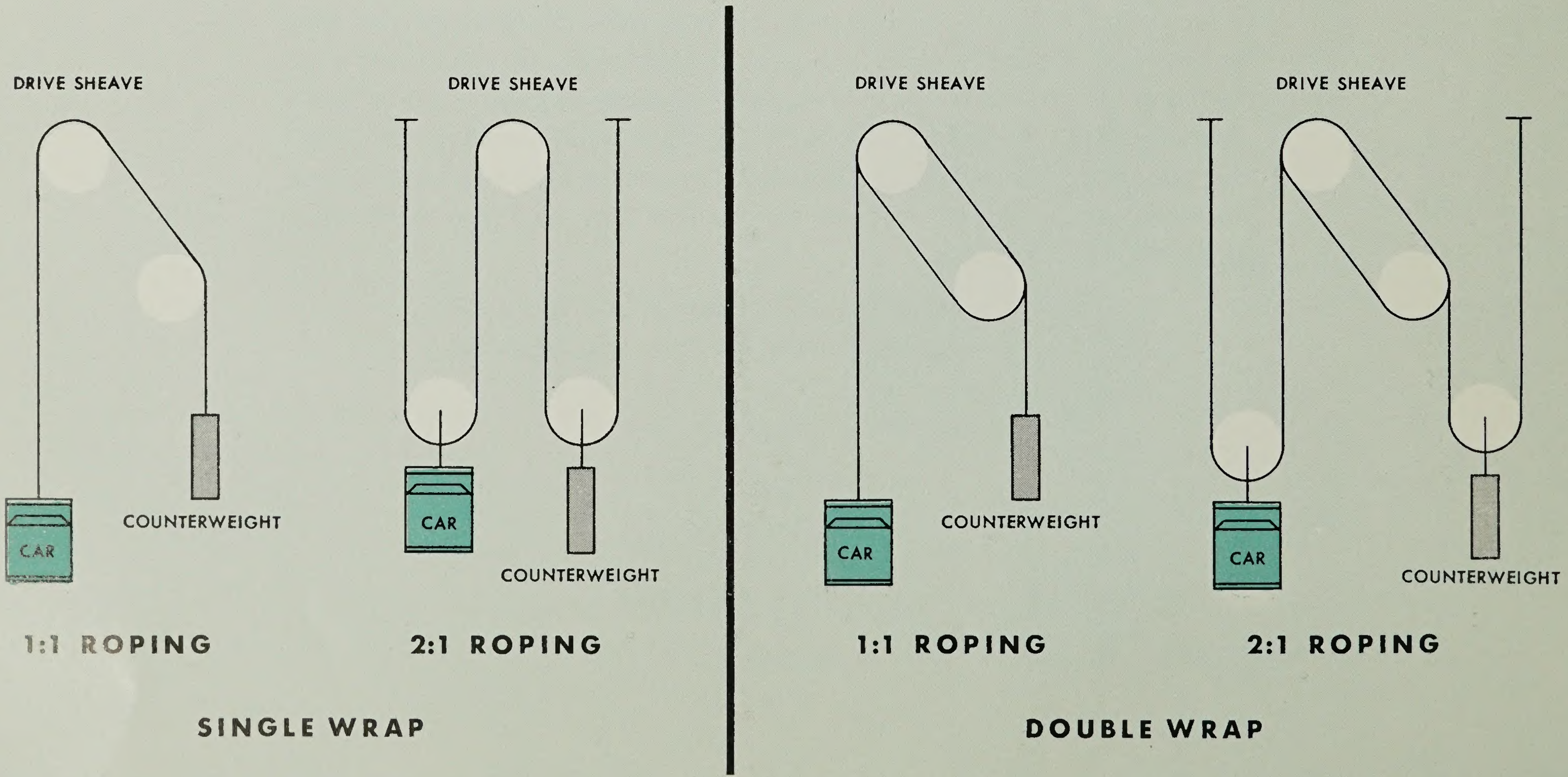


Figure 2. Schematic of Traction Type Elevators

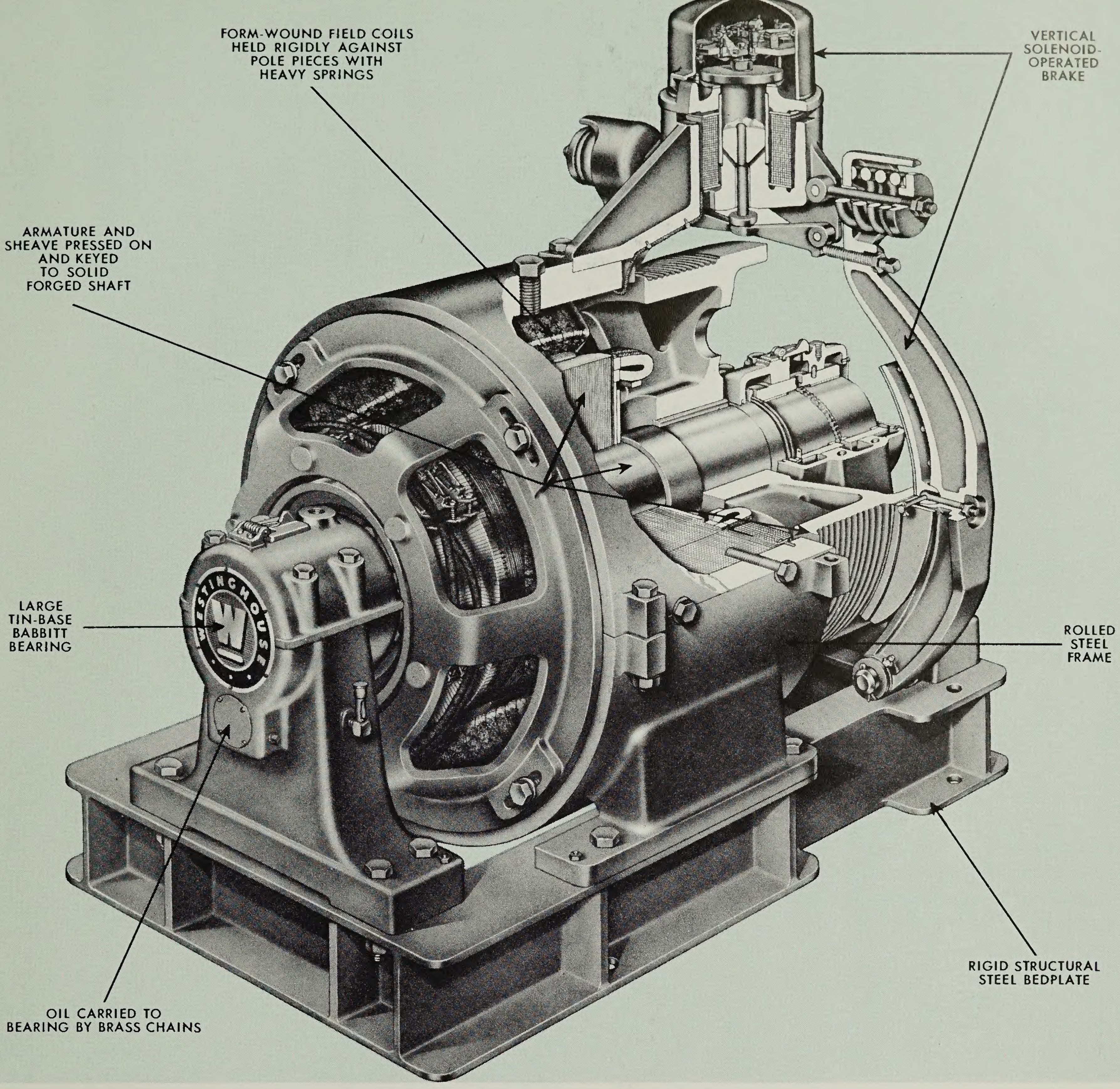

FORM-WOUND FIELD COILS HELD RIGIDLY AGAINST POLE PIECES WITH HEAVY SPRINGS
VERTICAL SOLENOID-OPERATED BRAKE
ARMATURE AND SHEAVE PRESSED ON AND KEYED TO SOLID FORGED SHAFT
WESTINGHOUSE
W
LARGE TIN-BASE BABBITT BEARING
ROLLED STEEL FRAME
RIGID STRUCTURAL STEEL BEDPLATE
OIL CARRIED TO BEARING BY BRASS CHAINS

Figure 3. Cutaway View of Gearless Machine

The geared machine is used with elevators of the rheostatic and variable voltage types up to a maximum speed of 350 feet per minute.

E. ISOLATED MACHINES *(figure 5)*

It is standard Westinghouse practice to sound isolate Geared Machines in hospitals and apartment houses. However, machine isolation is also available in any other type of building where it is desirable.

Sound isolation of a geared machine is accomplished with four compact, soundproofing units consisting of a plunger resting on rubber pads within a pipe welded assembly. Imbedded in the concrete floor, the soundproofing units are mounted on the machine I beams and support the machine. The type of rubber is selected to attenuate the predominating frequency of the elevator system.

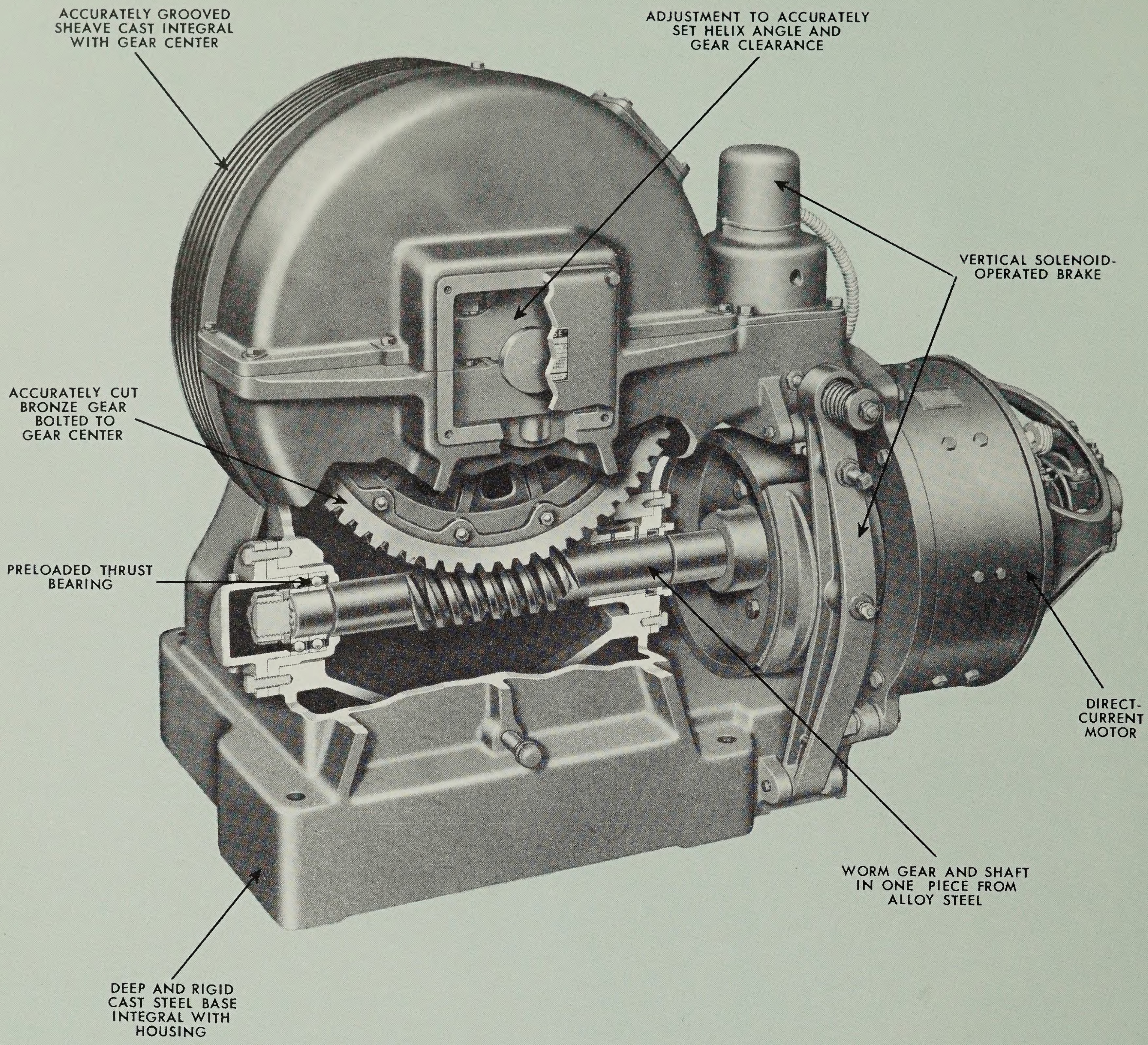

ACCURATELY GROOVED SHEAVE CAST INTEGRAL WITH GEAR CENTER
ADJUSTMENT TO ACCURATELY SET HELIX ANGLE AND GEAR CLEARANCE
VERTICAL SOLENOID-OPERATED BRAKE
ACCURATELY CUT BRONZE GEAR BOLTED TO GEAR CENTER
PRELOADED THRUST BEARING
DIRECT-CURRENT MOTOR
WORM GEAR AND SHAFT IN ONE PIECE FROM ALLOY STEEL
DEEP AND RIGID CAST STEEL BASE INTEGRAL WITH HOUSING

Figure 4.
Cutaway View of Geared Machine with
D-C Motor, Showing Worm Shaft Assembly

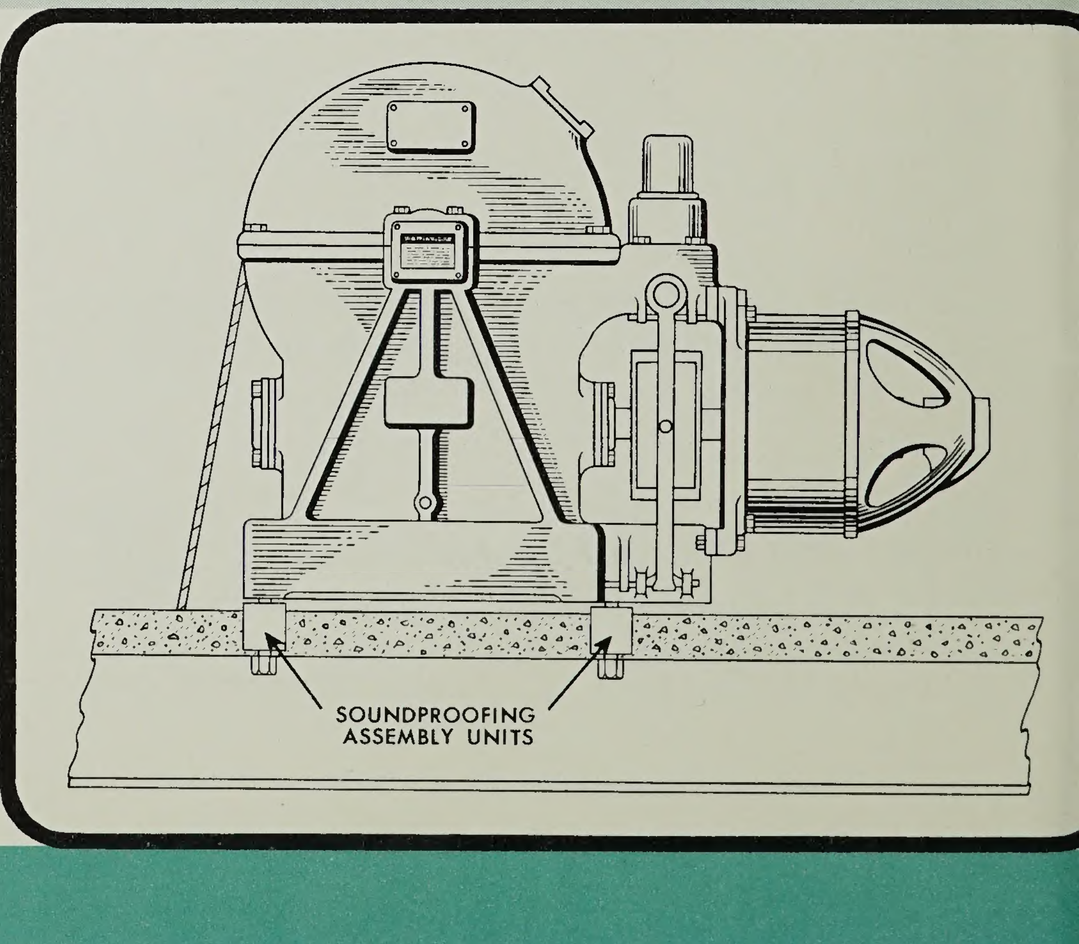


Figure 5. Isolated Geared Machine

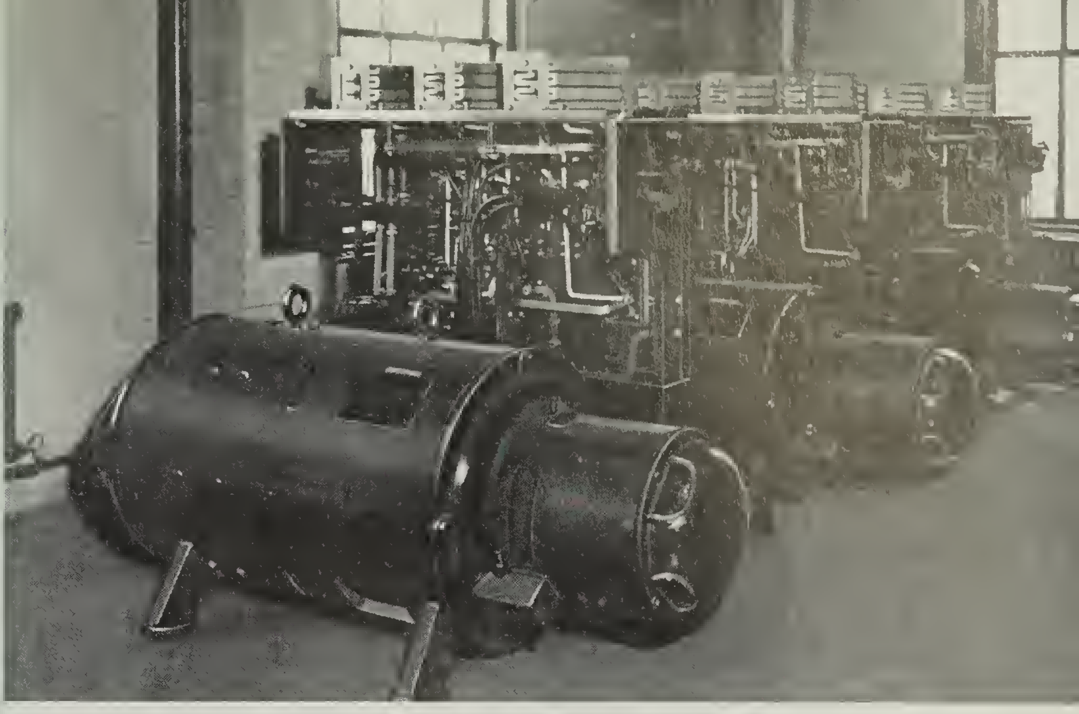


Figure 6. Motor Generator Sets

M-G SETS No. 113

M-G SET No. 324

REAR OF CONTROL PANEL SHOWN

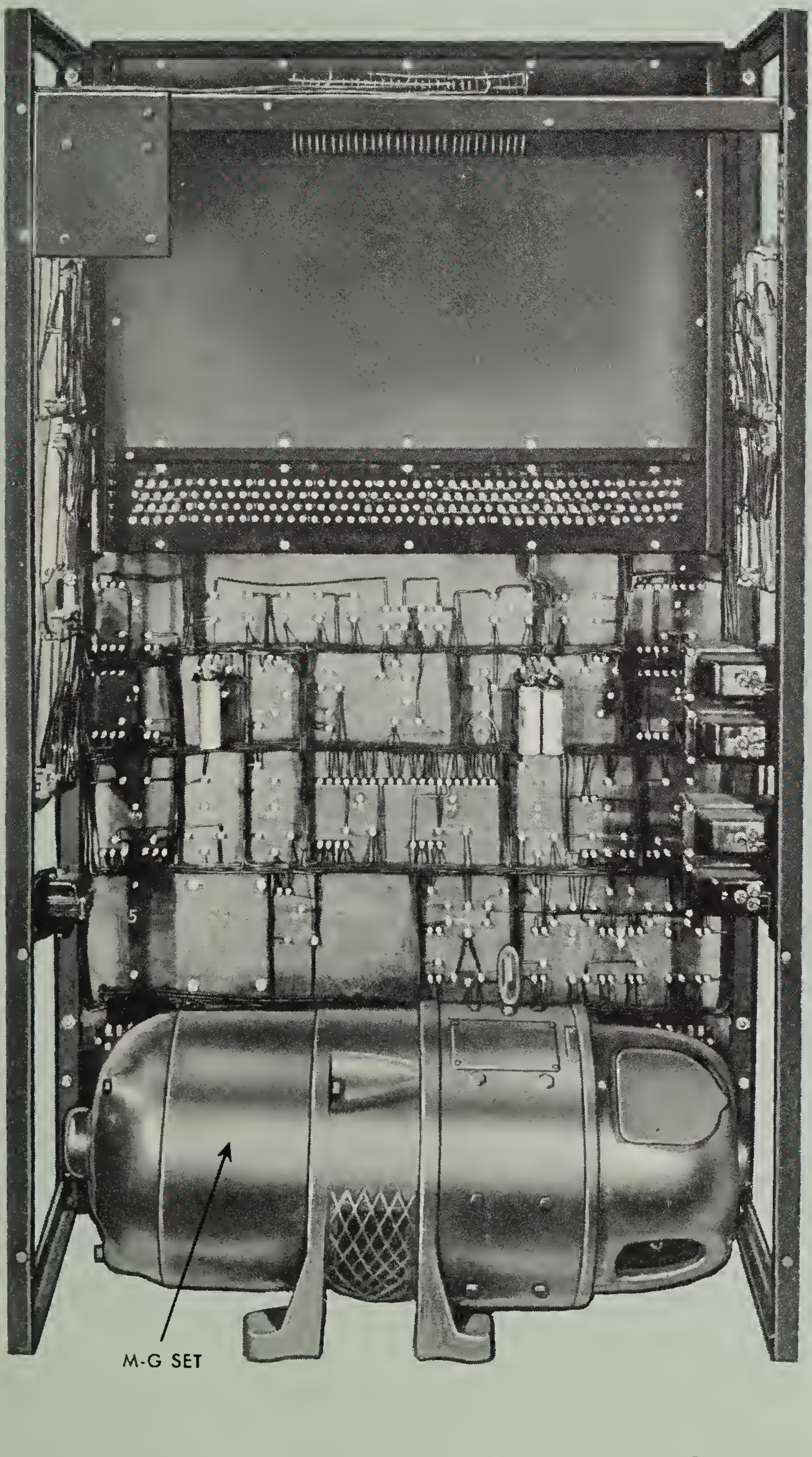


Figure 7. Motor Generator and Control Panel

F. MOTOR GENERATOR (M-G) SETS *(figures 6 and 7)*

If variable voltage equipment is specified, a motor generator set is supplied to furnish direct current to the elevator motor.

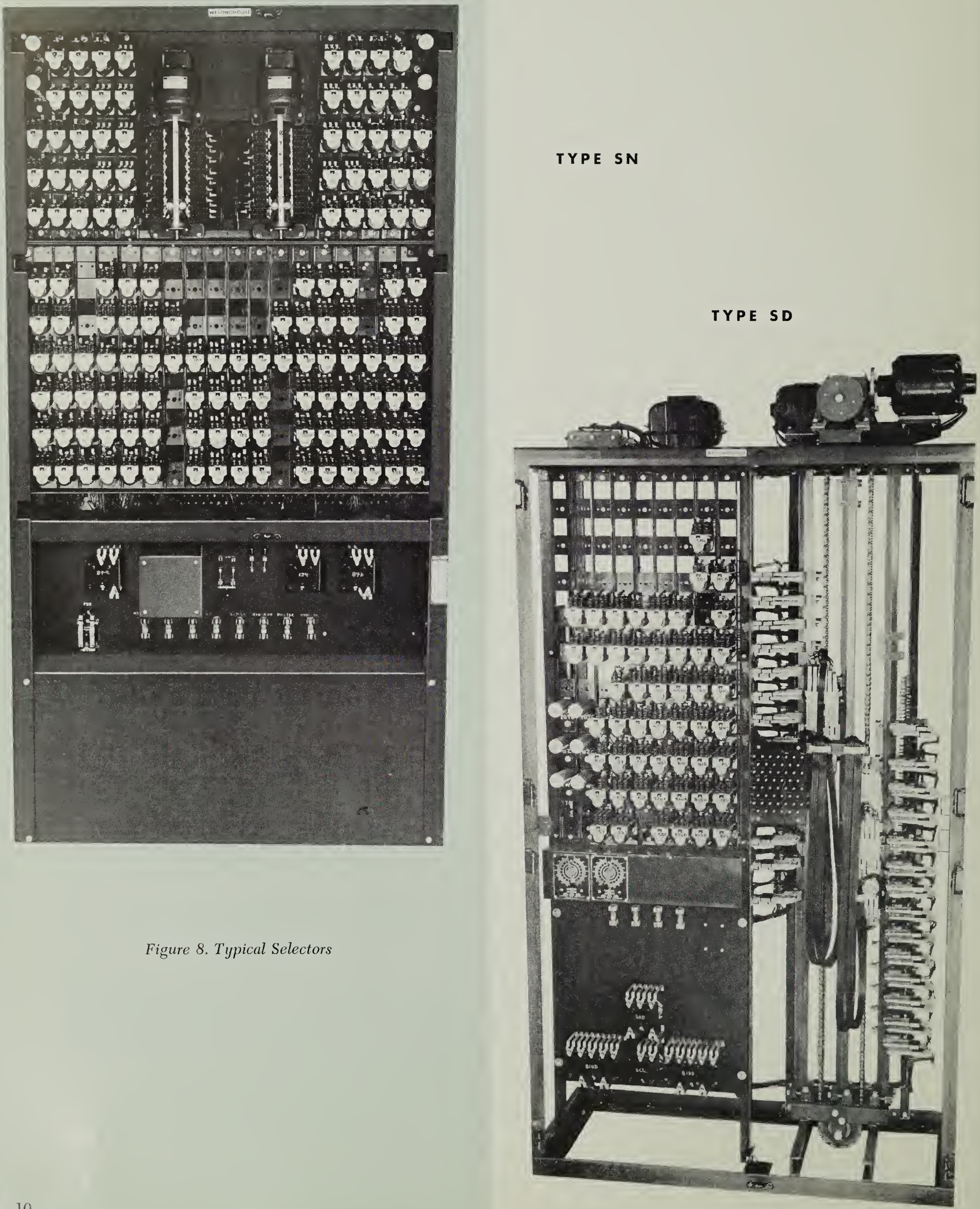
The motor generator set is of unit frame construction and is accurately balanced. It is supported by four legs welded to the frame, and is isolated from the building with neoprene blocks. A direct-connected exciter on the larger sizes and a dry type rectifier for the smaller sizes supply power for the control circuits, fields, and brake coils.

G. SYNCHRO-GLIDE LANDING

Synchro-Glide landing makes use of an electrically driven selector, inductors, inductor plates mounted in the hoistway, and a regulating system known as Rototrol.

> **NOTE:** For a description of Rototrol, see page 22, section III, paragraph a.

SELECTOR *(figure 8)*. The selector is a miniature elevator that moves in synchronism with the elevator car. Contacts mounted on it indicate to the control the car position at which slowdown should be initiated.



TYPE SN

TYPE SD

Figure 8. Typical Selectors

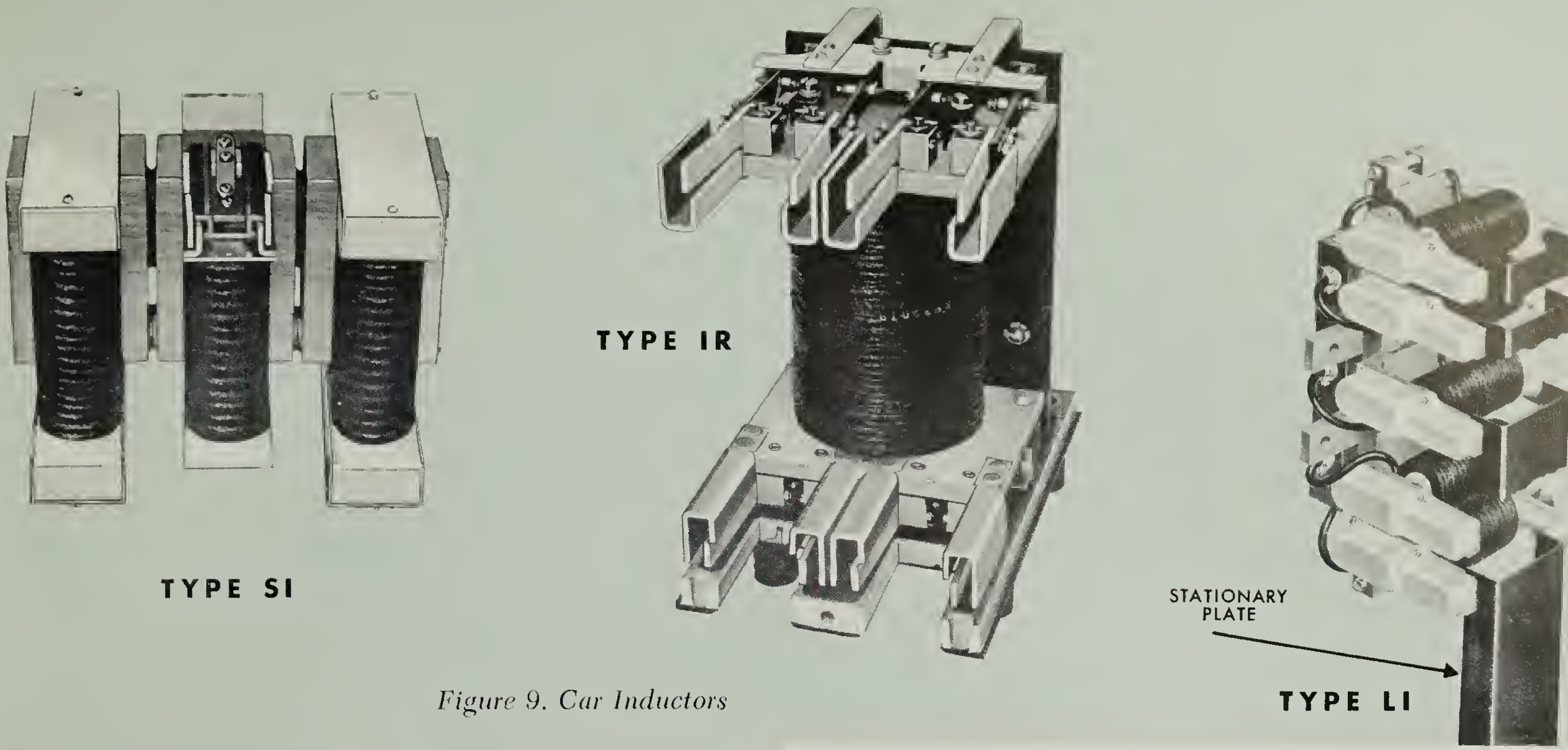


Figure 9. Car Inductors

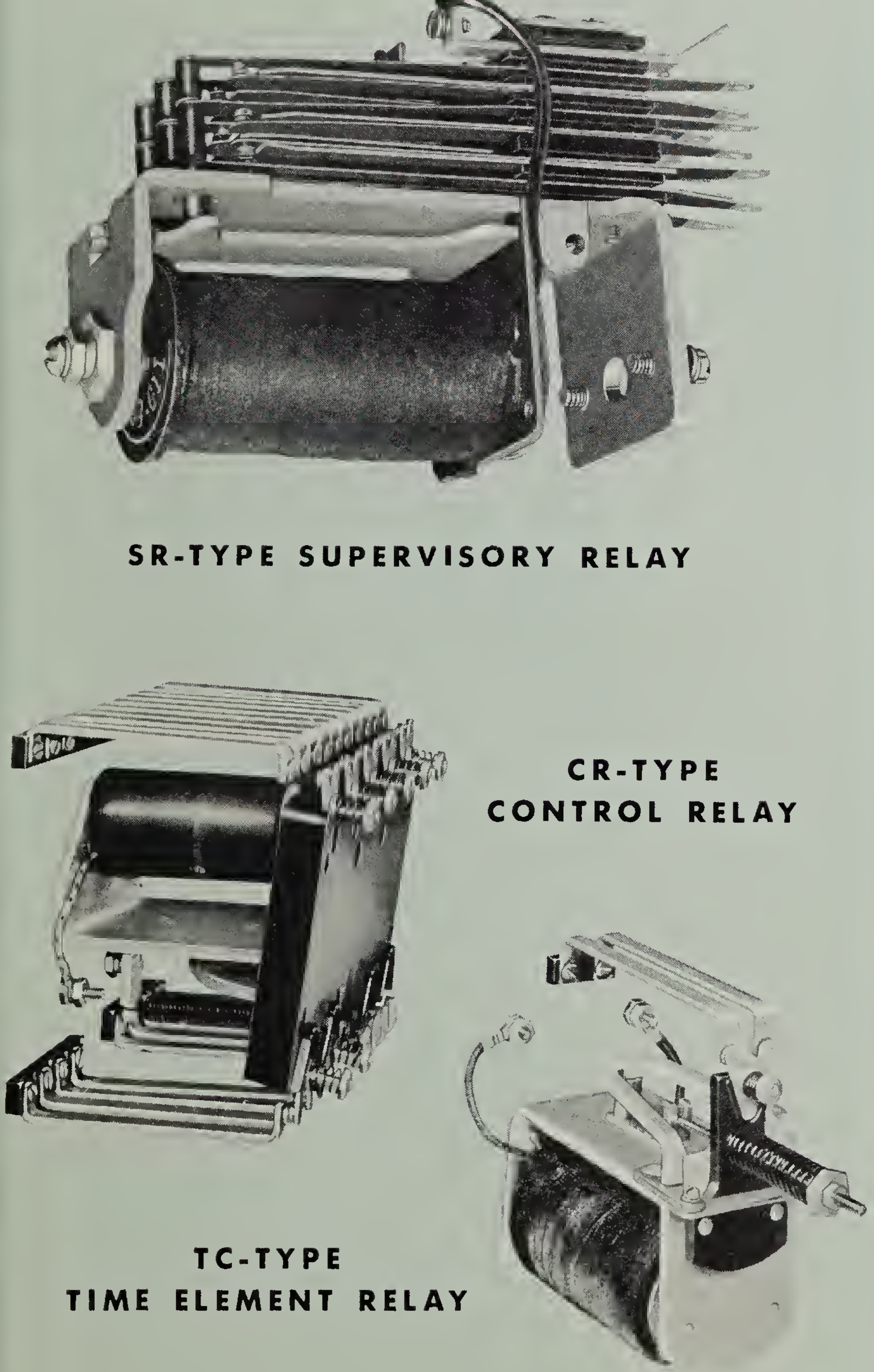


Figure 10. Shuntless Relays

INDUCTORS *(figure 9).* The inductors are mounted on top of the elevator car. Inductors consist of contacts, a coil, and a magnetic core. When the slots in the switches pass the stationary iron plates mounted in the hoistway, a magnetic circuit is completed and the contacts are caused to open and thereby, through relays, indicate to the control that the car has arrived at a specific point in the hoistway.

The inductor system lands the car at floor level automatically, accurately, rapidly, and smoothly. It saves the time that other systems need for releveling. It also saves power, and prevents the excess wear on equipment that results when the elevator overruns the landing and is required to level back to the floor.

H. SHUNTLESS RELAYS *(figure 10)*

Westinghouse shuntless relays have been in use since 1935 beginning with the supervisory relay which was patterned after telephone relays. The development was completed with the addition of control and time relays. All flexing shunts have been eliminated. Open circuits have been minimized by the elimination of shunts and by the use of soldered connections thereby assuring maximum over-all reliability. Coils and contacts are easily replaceable.

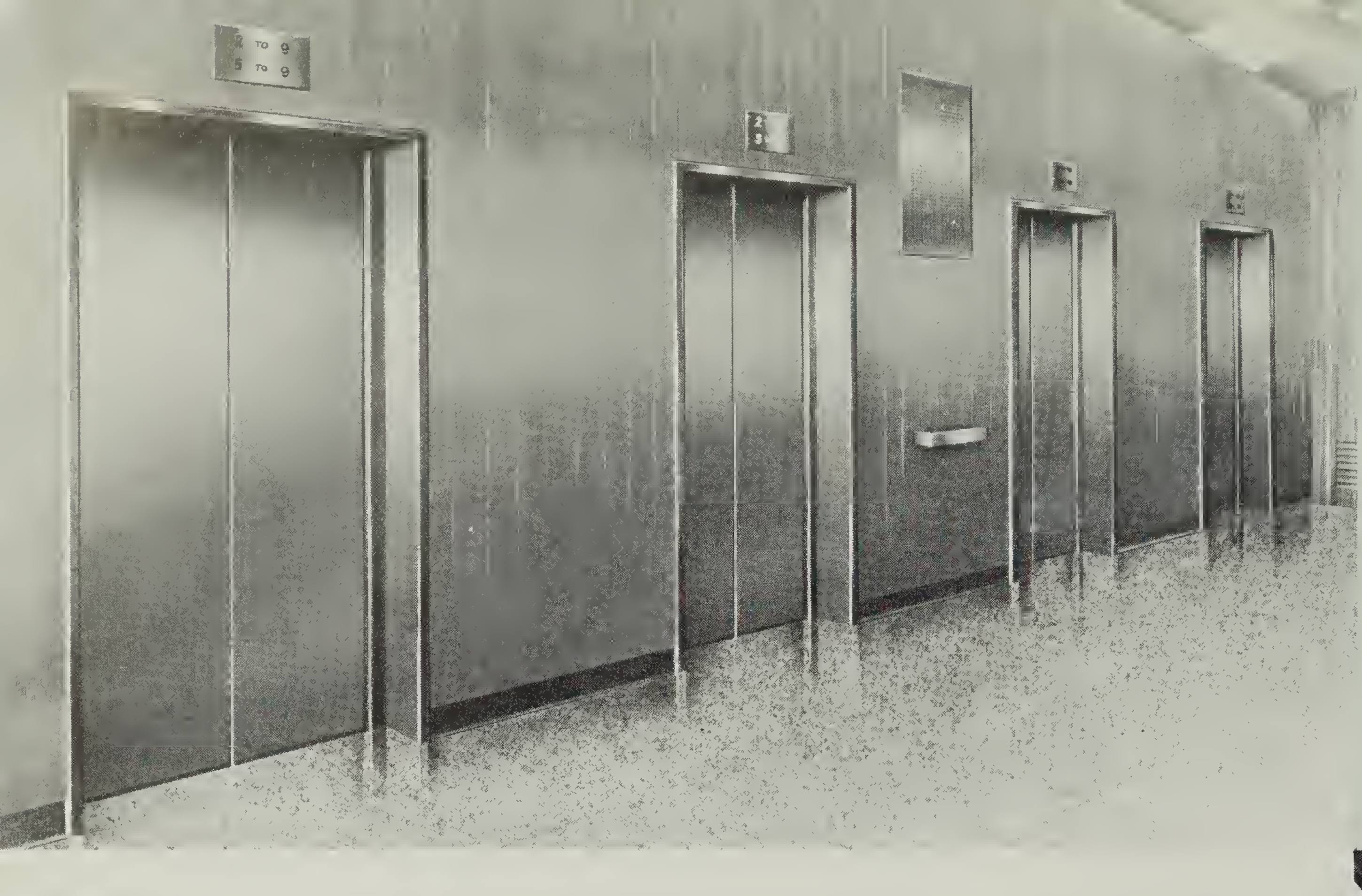


Figure 14. Hoistway Doors

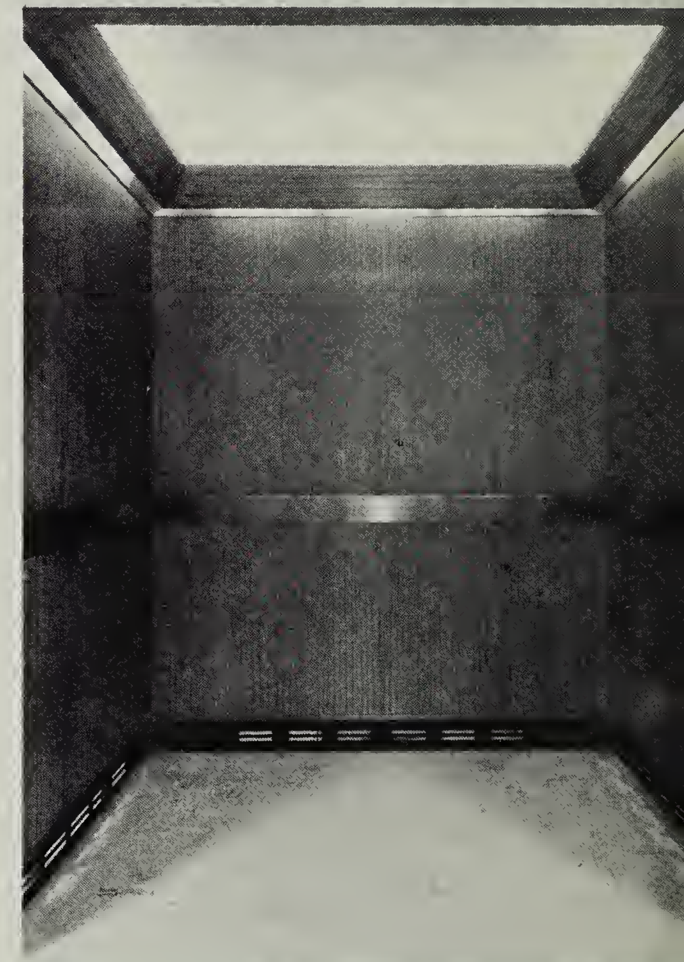


Figure 13. Typical Cabs

L. CAB *(figure 13)*

Modern cabs are generally of wood or metal construction or a combination of both, utilizing natural finished woods and metals such as bronze, stainless steel, aluminum, or nickel silver for various accessories and appointments.

Cabs are equipped with power-operated sliding doors, lights, fan fixture, and other accessories as required. The cab is isolated from the sling with rubber pads.

Cab doors are hung on door hangers that have sound-reducing long-life treads.

> **NOTE:** For a description of Westinghouse door hangers, see page 14, this section, paragraph N.

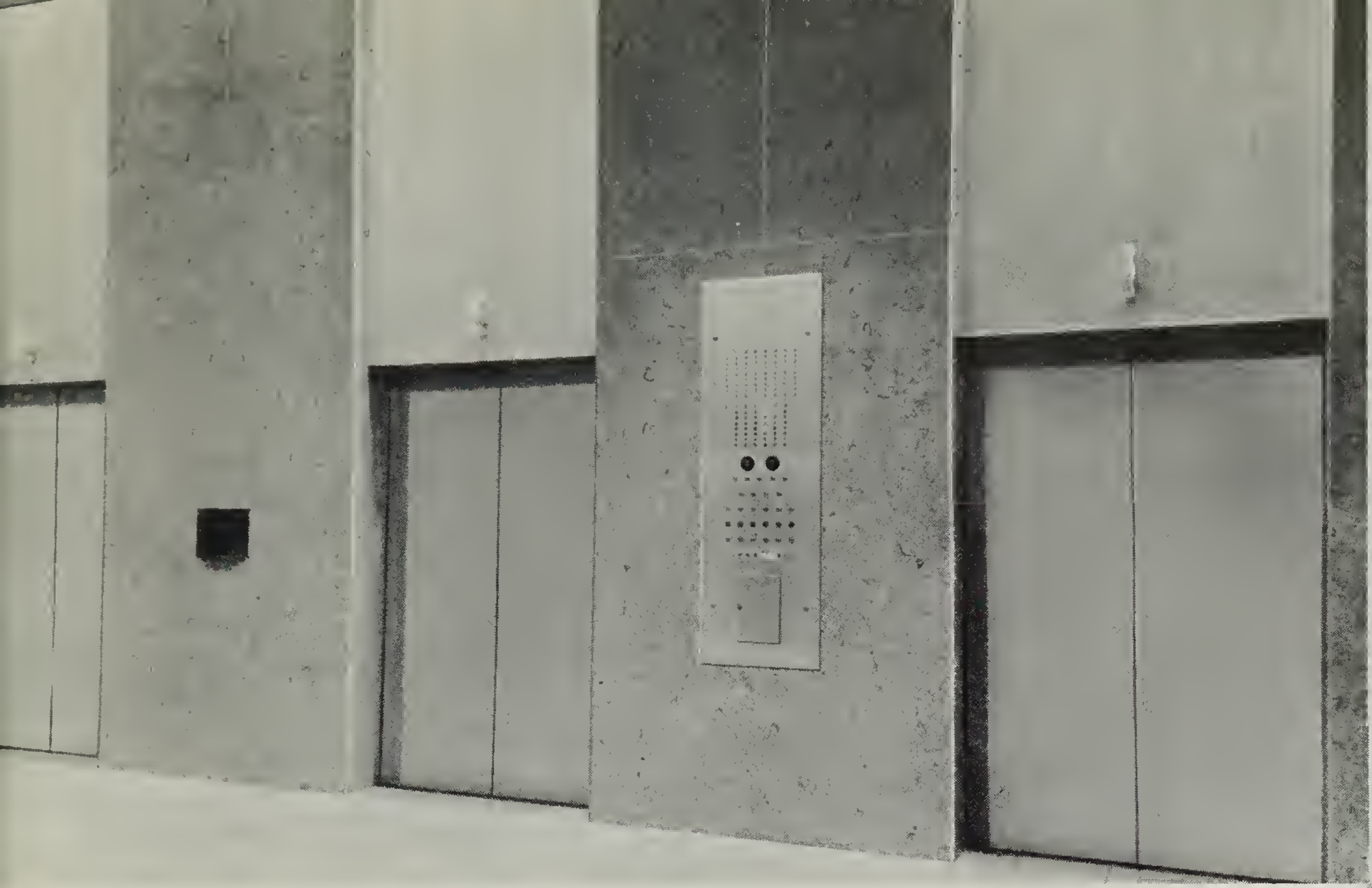


Figure 14. Hoistway Doors

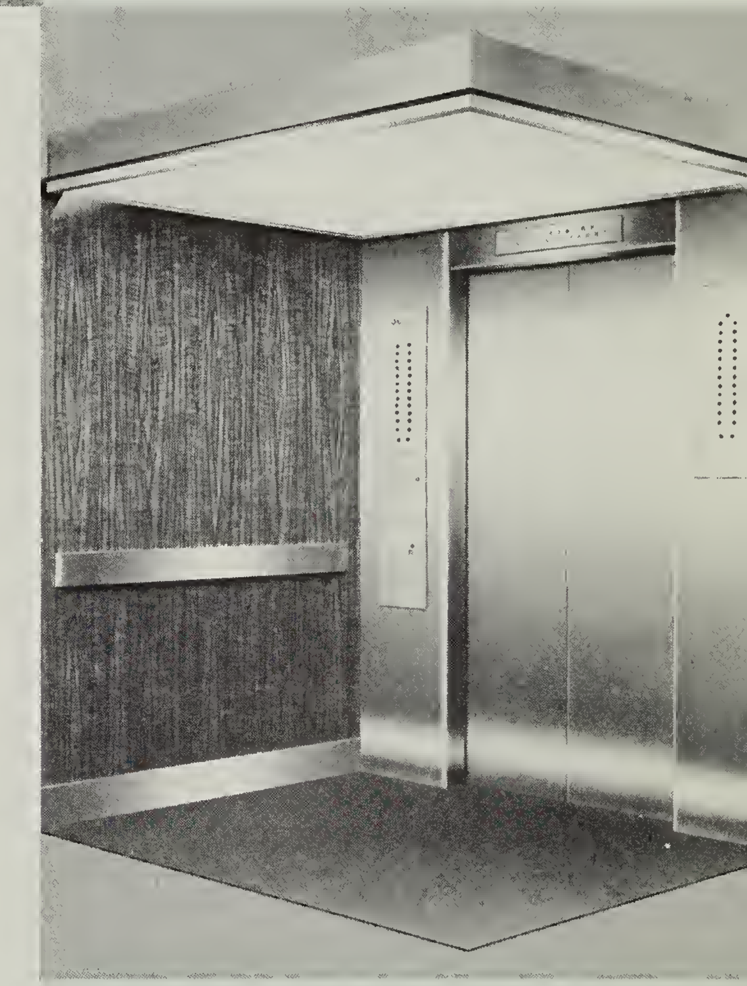


Figure 13. Typical Cabs .

M. HOISTWAY DOORS *(figure 14)*

Hoistway doors are of four types. They are, for their typical applications: single-speed for apartment houses, two-speed for hospitals, center-opening for general purpose, and two-speed center-opening for department stores.

Doors are power-operated. Their speed is adjusted to suit the method of operation. On automatic elevators the closing speed is reduced to a little over one foot per second to comply with code requirements as to kinetic energy. In the case of automatic elevators equipped for attendant service, the closing speed is automatically increased to full speed where an attendant is operating the car.

The car door panel of automatic elevators is always supplied with a protective device which operates to reopen the doors if it meets an obstruction when closing.

N. DOOR HANGERS *(figure 15)*

Westinghouse has several types of hangers for hoistway and car doors.

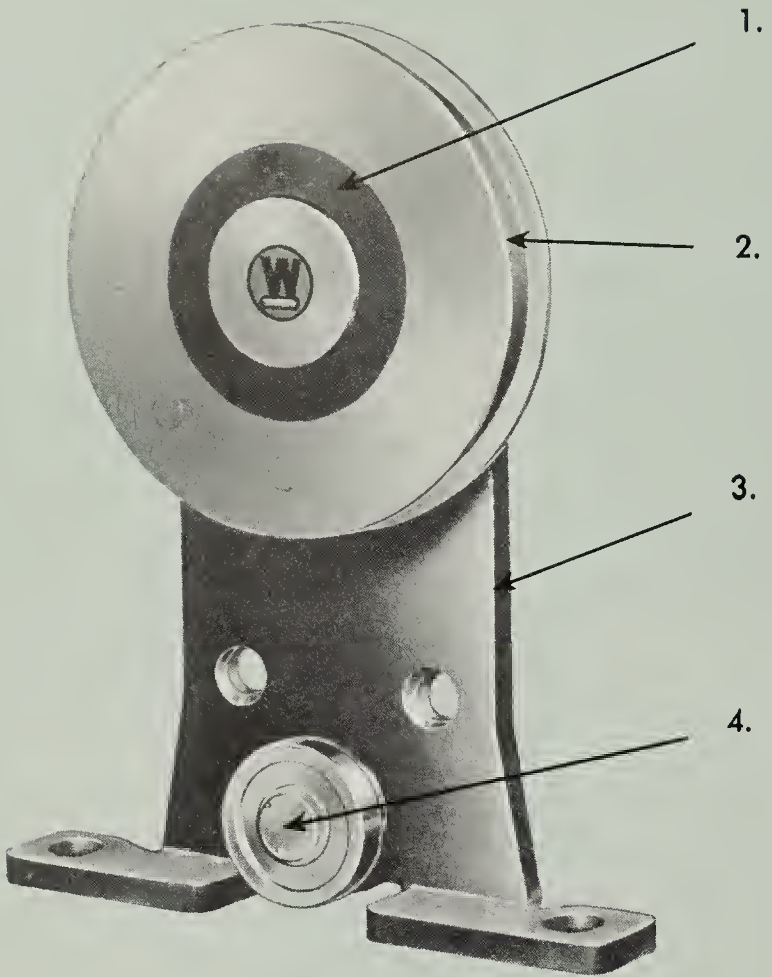
The hangers are of the sheave type. They support the door panels and provide quiet, smooth, and efficient operation of the door system. They are compact units requiring a minimum of space. The eccentric stud, on which the up-thrust roller is mounted, provides adjustment for the proper alignment of the sheave and roller with the track at all times. The steel track with rounded edges is bracketed to the structure and forms a true uniform surface for the hanger sheave.

1. Grease-packed precision ball bearings

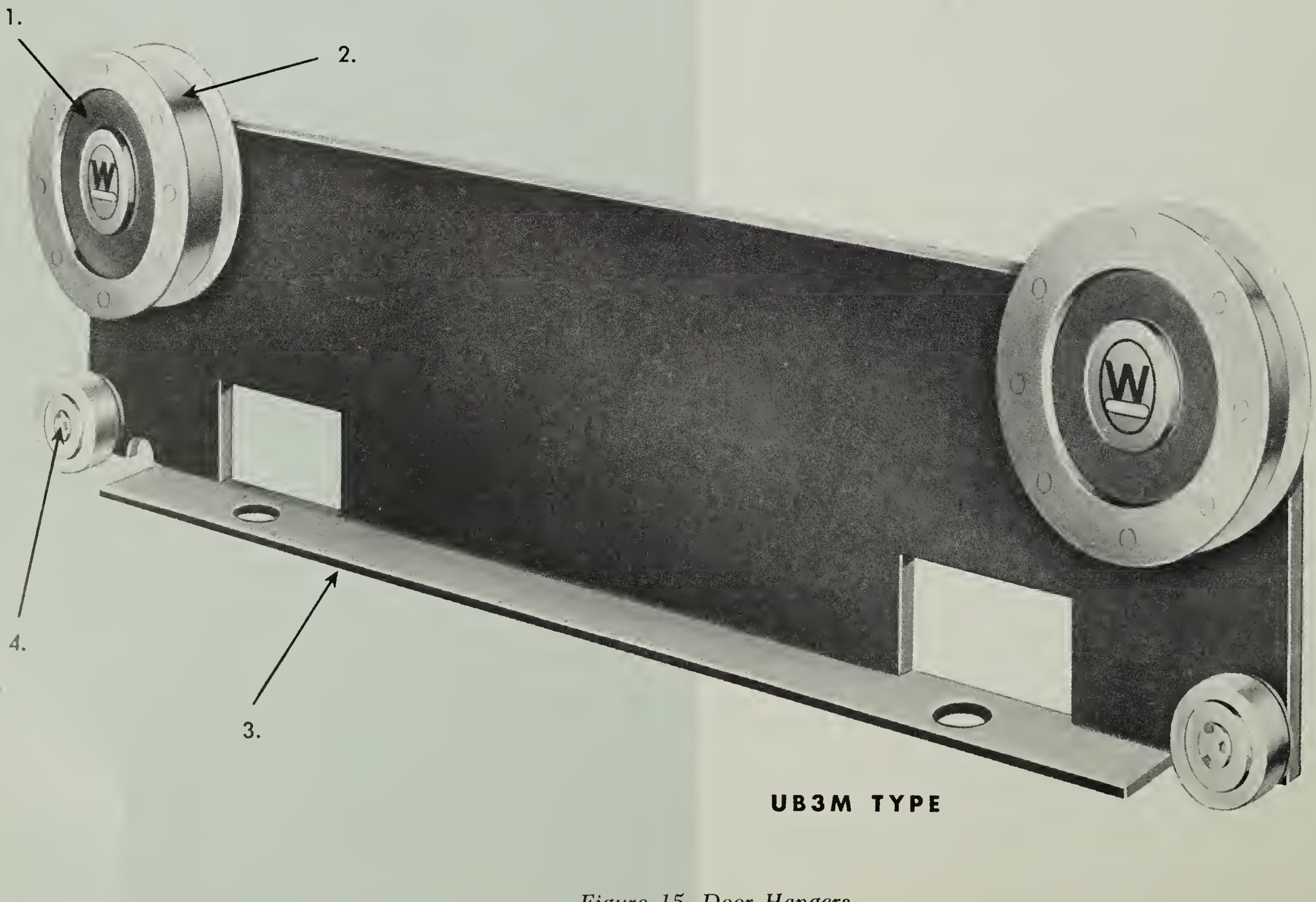
2. Quiet hanger sheave with durable sound-reducing disc mounted to outer race of ball bearing and locked between steel side plates

3. Sturdy steel hanger plate

4. Up-thrust roller on eccentric cold-rolled steel stud



A3M TYPE



UB3M TYPE

Figure 15. Door Hangers

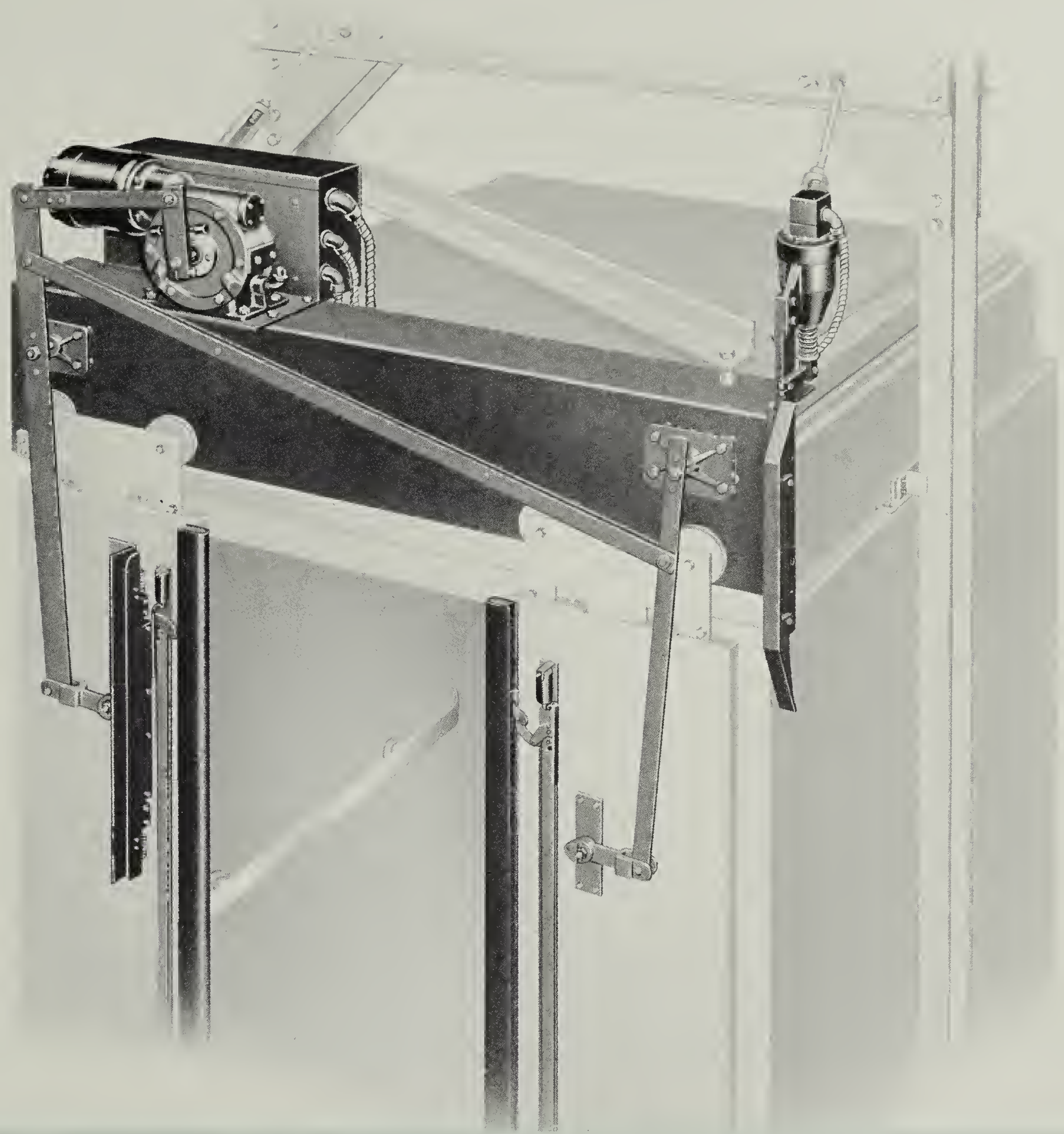


Figure 16. Master Type Operator

O. DOOR OPERATORS *(figure 16)*

The Westinghouse medium and high-speed mastertype door operators simultaneously open and close car and hoistway doors quickly, quietly and smoothly. The operators are readily applicable to single, two-speed and center-opening slide doors.

Door opening and speed are readily adjustable to suit individual installations. The operators are compact, durable and lightweight and are individually adjusted for speed and acceleration and provide dynamic braking.

For all operators, the electric contact on the car door and the electric interlock on the hoistway door will prevent movement of the car unless the car and hoistway doors are locked (as defined by code) in the closed position. In case of failure of power to the door operator, the doors may be manually operated at any floor.

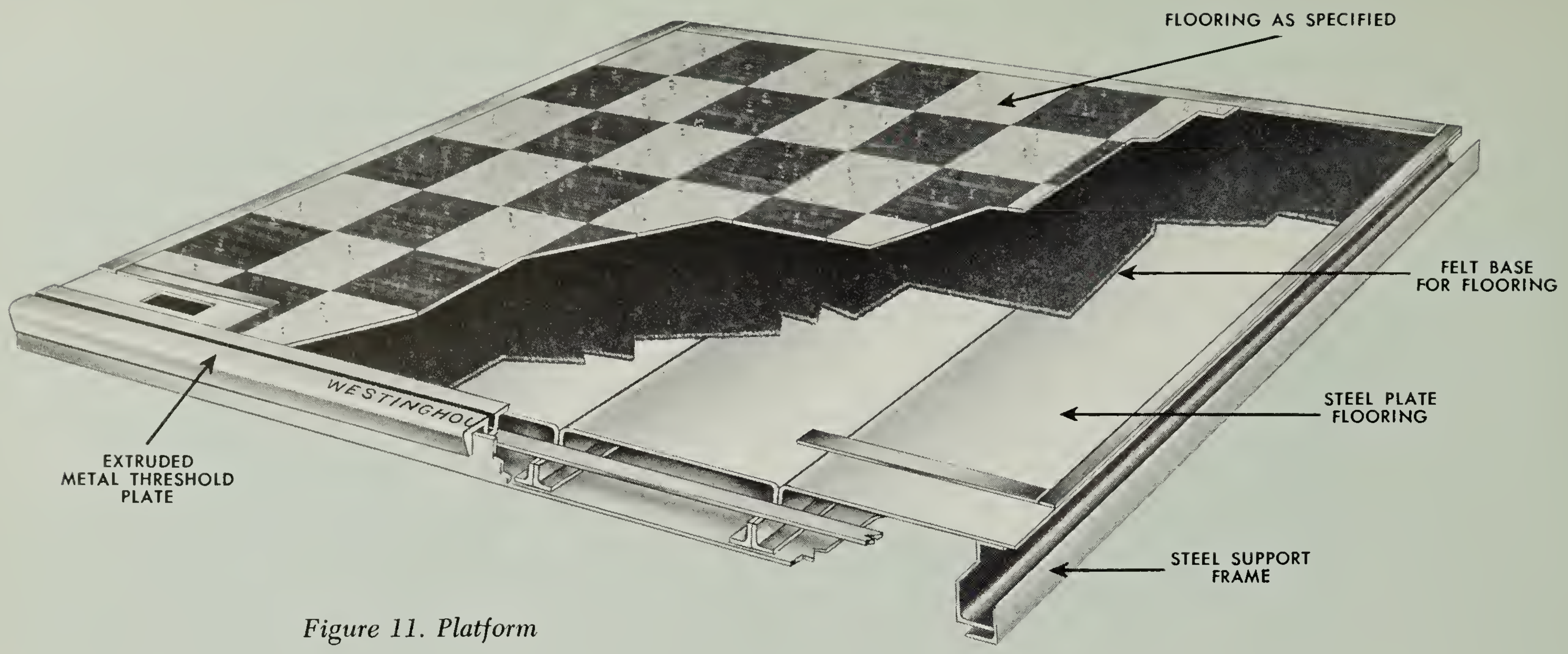


Figure 11. Platform

J. PLATFORM *(figure 11)*

Westinghouse passenger elevator platforms are designed and built to exacting specifications. The one-piece platform is mounted in a rigid support frame fastened to the sling.

Isolation. The platforms are isolated from the slings by thick rubber pads. The elevator cab is bolted to the platform without direct connection to the support frame.

K. SLING *(figure 12)*

Elevator car slings provide adequate support for the cars, their loads and accessories. They consist of a crosshead, a bottom beam, stiles, and diagonal braces. The elevator guide shoes are mounted on the crosshead. A Westinghouse designed and built safety device is integral with the bottom beam.

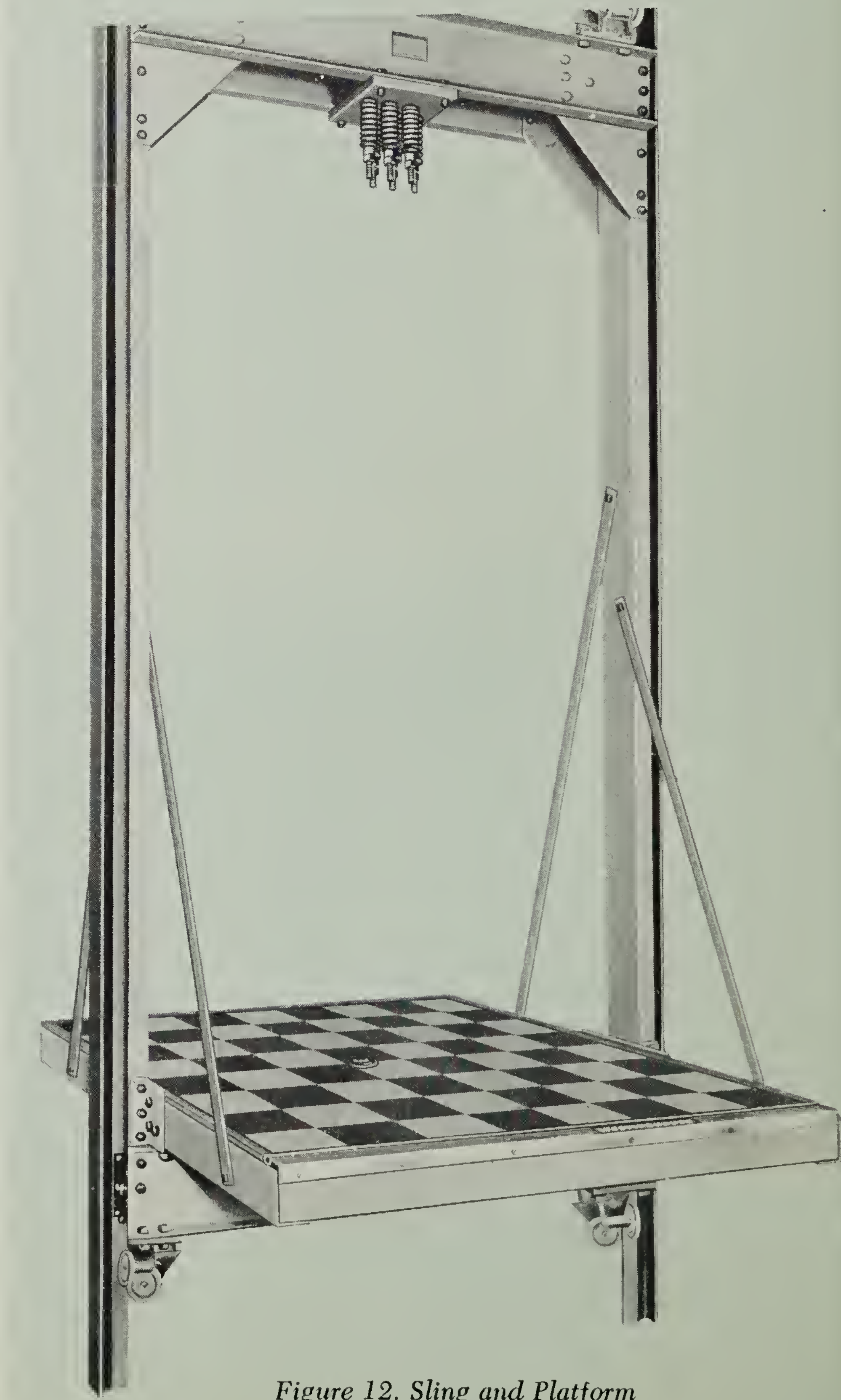


Figure 12. Sling and Platform

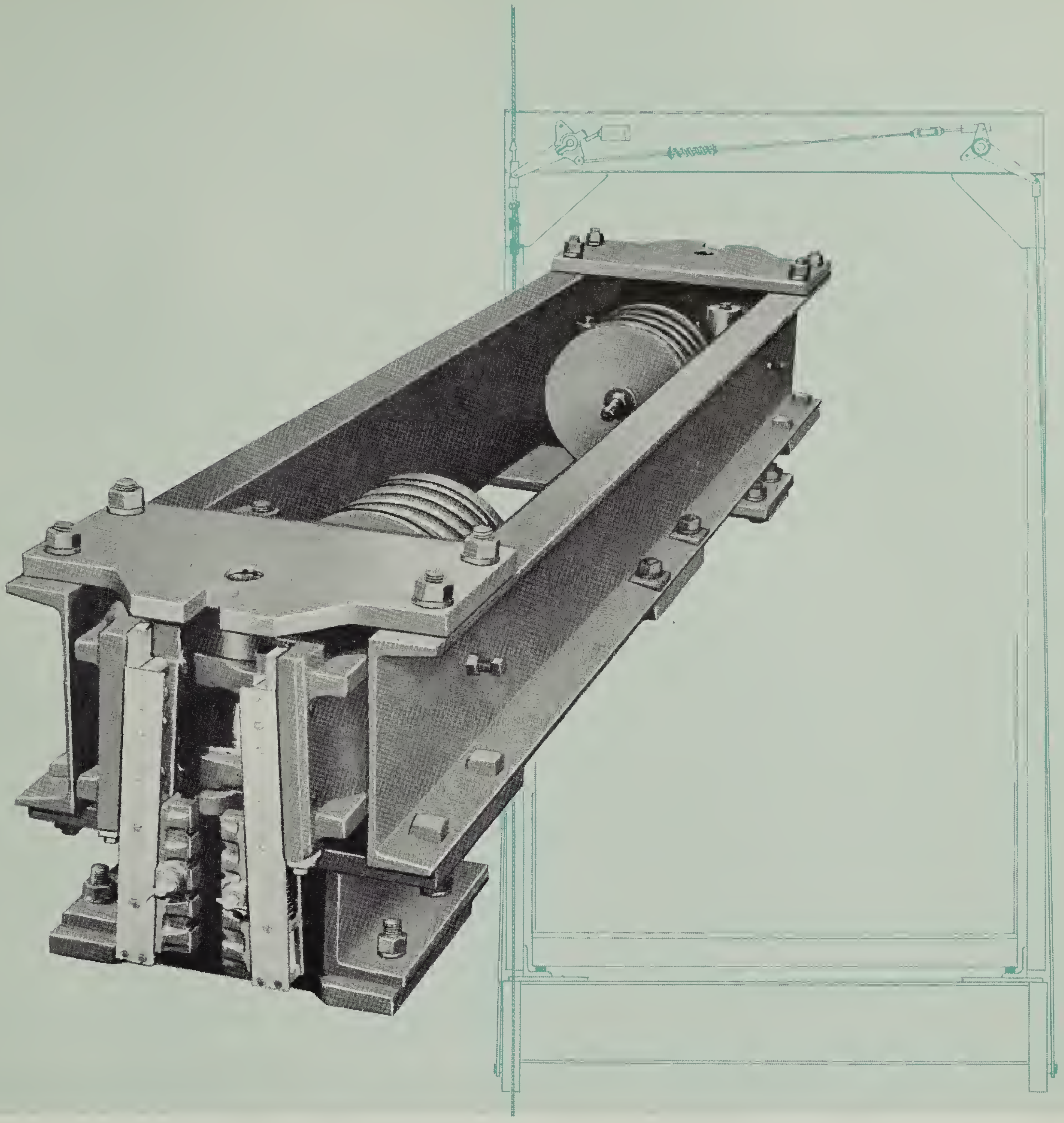


Figure 17. Flexible Guide-Clamp Safety

P. SAFETY

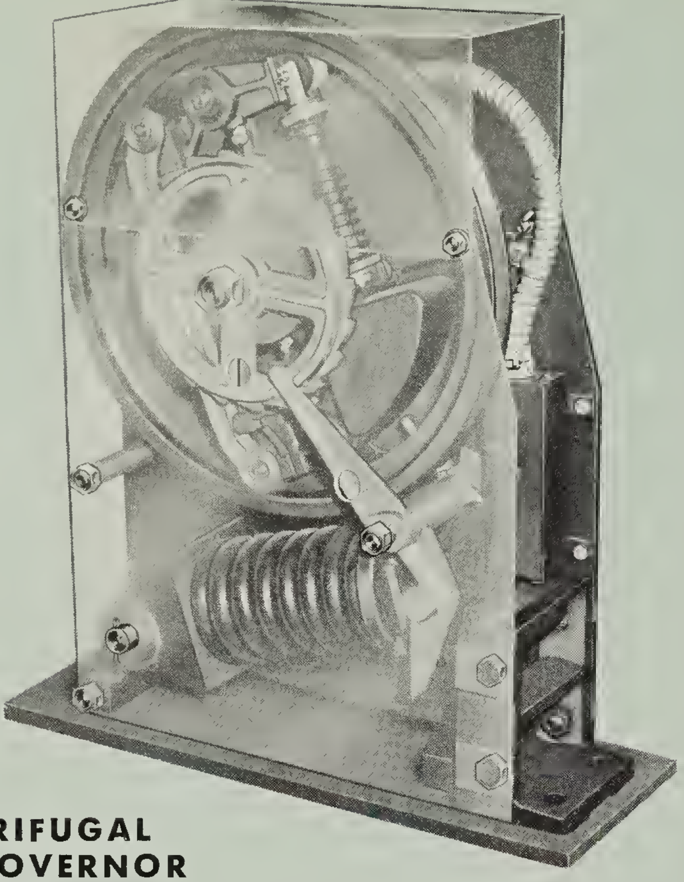
1. Flexible Guide-Clamp Safety *(figure 17).* This safety is used on all medium and higher speed passenger elevators. The safety mechanism is incorporated in the bottom beam of the sling, under the platform. It exerts retarding force in not more than 30 inches of car travel after the operation of the governor in case of overspeed. A constant retarding force is applied to the rails by two pairs of steel jaws with equalized pressure. This braking force is sufficient to bring the car and load to a smooth and gradual stop. Normal running clearance is one-fourth inch between each safety jaw and the rail.

2. Instantaneous Safety. This safety is used on all slow speed passenger elevators. It is incorporated in the bottom beam of the sling. When the safety mechanism is tripped, a knurled steel roller at each end of the bottom beam is inserted between the safety casting and the surface of the rail. The heavy safety casting is pivoted and spring-biased so that the rollers may be forced between the casting and the rail without any sling or guide shoe distortion. Normal running clearance between each safety jaw and rail is approximately one-fourth inch.

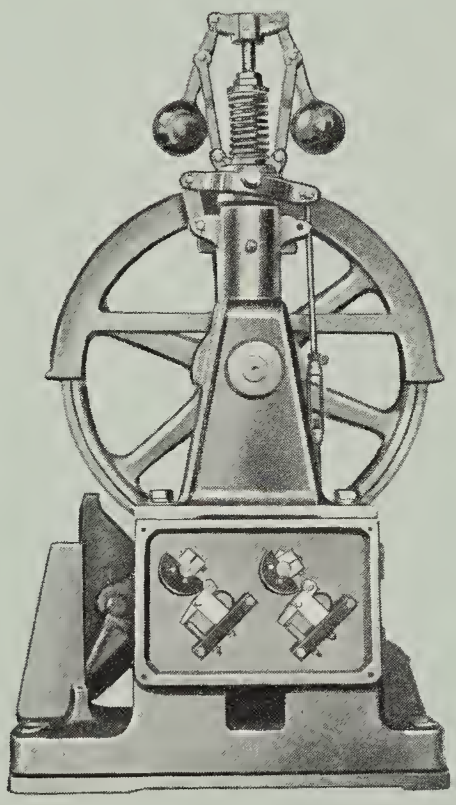
Q. GOVERNORS *(figure 18)*

Westinghouse governors are of two general types: the FLYBALL type and CENTRIFUGAL type to care for various elevator speeds. The flyball type governor is for use with elevators of higher speeds while the centrifugal type governor is used for lower speeds.

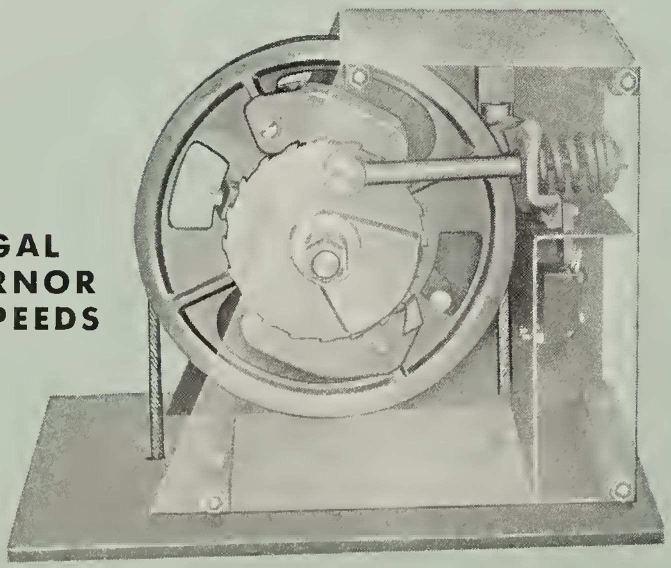
The function of the governor is to safeguard against overspeeding of the car. This is accomplished in the following manner: If a car begins to speed beyond its limit, the governor contact is opened thereby cutting off the power and applying the machine brake. Should the car continue to overspeed, the spring-backed parallel jaws are released. These jaws grip the governor rope with a predetermined pressure sufficient to actuate the safety mechanism without abrading or abnormally stressing the governor rope.



CENTRIFUGAL TYPE GOVERNOR FOR MEDIUM SPEEDS

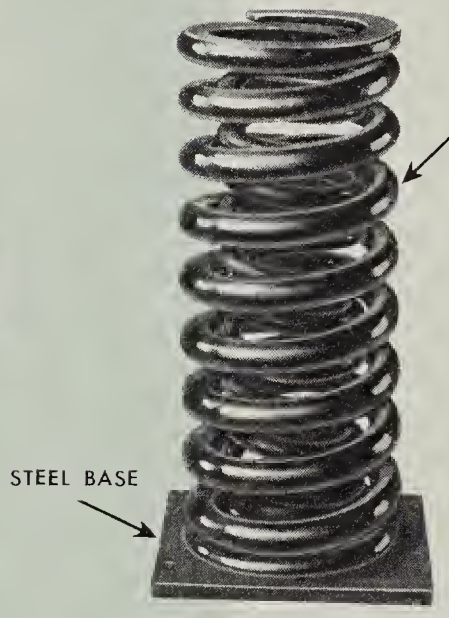


FLYBALL TYPE GOVERNOR FOR HIGH SPEEDS

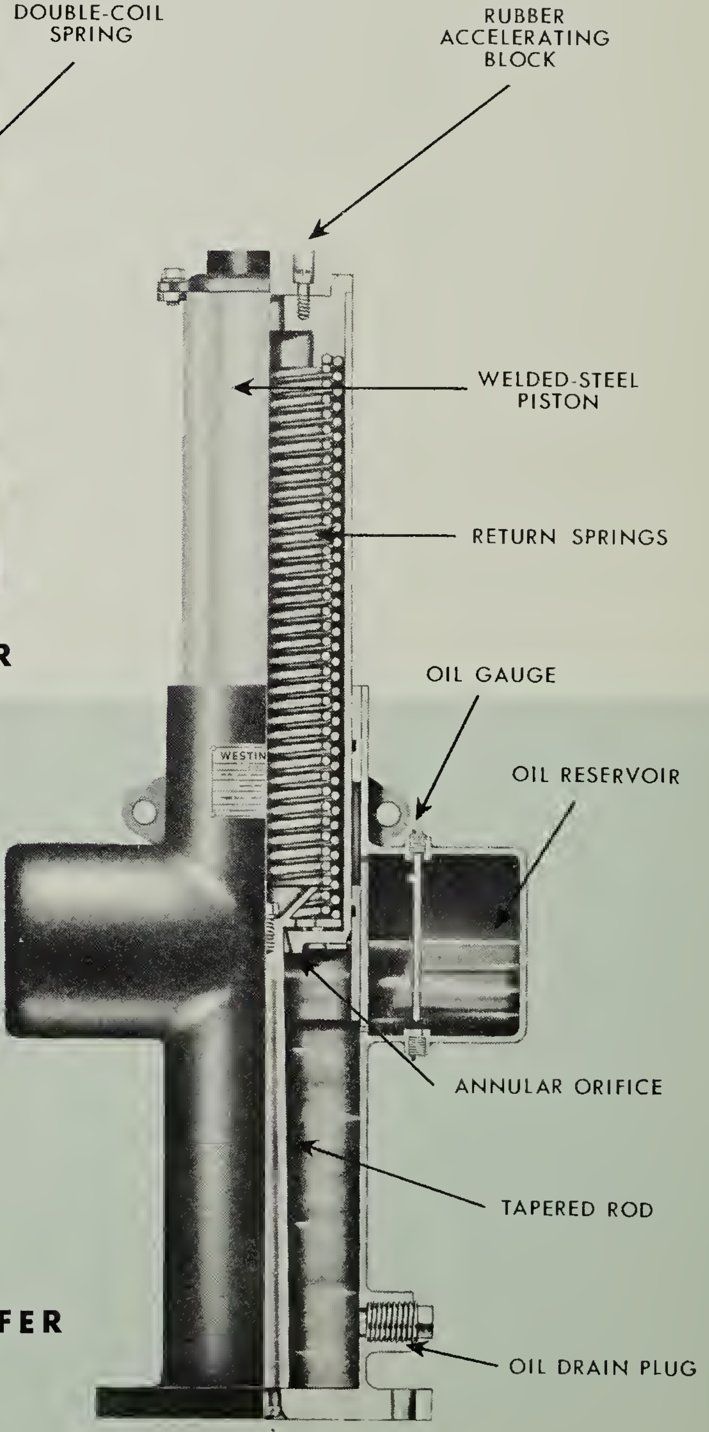


CENTRIFUGAL TYPE GOVERNOR FOR LOW SPEEDS

Figure 18. Governors



SPRING BUFFER



OIL BUFFER

Figure 19. Buffers

R. BUFFERS *(figure 19)*

The buffers, located in the pit, are designed to bring the car and counterweight to rest from governor tripping speed.

*1. **Spring buffers*** are designed of heavy spring steel, helical-shaped and of sufficient strength to retard and stop the car. They are used with elevators having speeds up to and including 200 feet per minute.

*2. **Oil buffers*** are of the spring-return type and are constructed like a modern gun recoil mechanism. They retard the car at an average rate of 32 feet per second (gravity) without noticeable peaks.

S. COUNTERWEIGHT

The Westinghouse standard counterweight consists of a welded frame in which cast iron subweights are mounted. The weight of the counterweight is normally equal to the weight of the car plus 40 percent of the capacity. This amount of overbalance usually results in the lowest power consumption and, under normal conditions, will provide adequate traction with both loaded and empty car.

T. GUIDE RAILS AND SHOES

Guide Rails. Westinghouse steel guide rails are of standard section and weight. They are machined accurately on the face and two sides. The ends are tongued and grooved to insure proper alignment and smooth, even-running surfaces. The backs of the rails are milled to receive heavy fish plates that are used to fasten one rail to another. Where the normal spacing of structural beams is not sufficiently close, additional members to which the guide rails may be fastened should be incorporated in the steel structure.

Sliding Rail Clips. *(figure 20)*

Guide rails are erected with the bare framing of the building. As the building materials are added and the structure tenanted, the columns shorten due to compression of the materials.

If guide rails are rigidly fastened to the building frame they tend to act as columns and support some of the weight. The result is bent rails.

On high-rise elevators this is overcome by fastening the guide rails to the building frame with "sliding" rail clips.

The sliding rail clip is basically a spring which exerts sufficient pressure to hold the rail, but permits the rail to slide in the clip before there is sufficient stress to bend the rail. A brass liner is used between the rail and the clip to prevent freezing due to rust.

GUIDE SHOES.

*1. **Roller Guide Shoes** (figure 21).* Roller guide shoes are provided both for cars and counterweights. Special tread construction of rubber bonded to a heavy gauge pressed steel rim forms a tough yet flexible tread. They operate on dry rails and thus reduce fire hazard and maintenance, and assure a clean hoistway and pit. The bearings are prelubricated and sealed. Face rollers of car guides are equipped with a rubber spring to maintain contact with the rail. Both the face and side roller assemblies are equipped with eccentric spindles for adjustment of pressure against rails. Rubber bushings minimize vibration, reduce noise, and allow the rollers to follow rail irregularities.

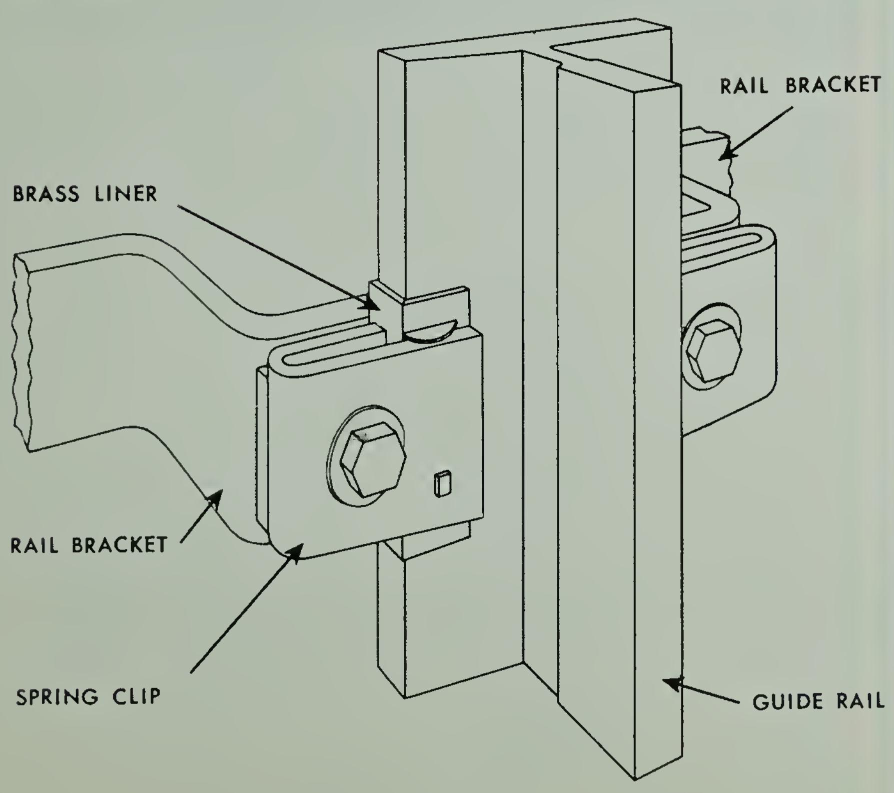


Figure 20. Guide Rails with Sliding Rail Clips

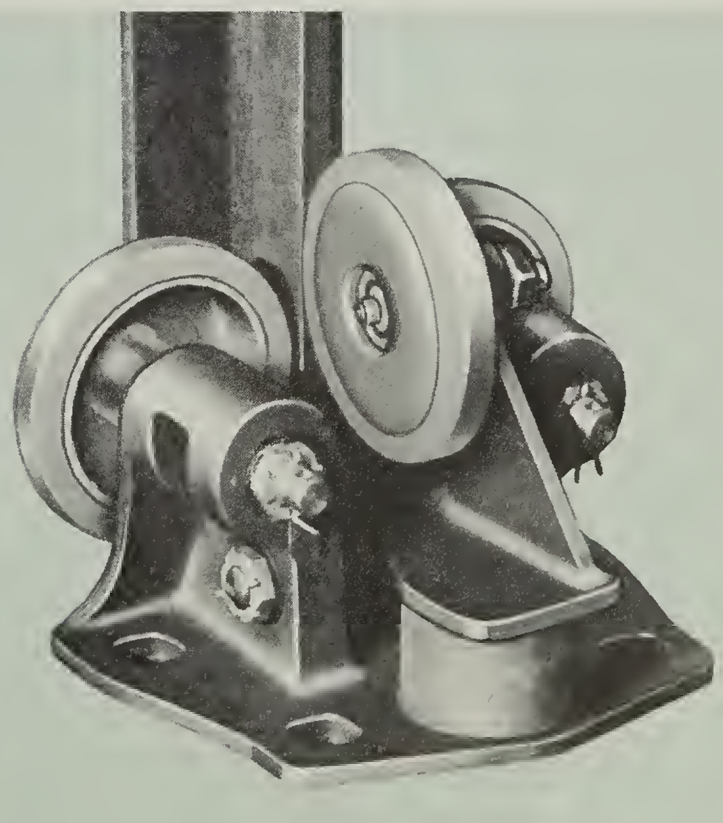


Figure 21. Roller Guide Shoes

*2. **Flexible Guide Shoes.*** Flexible guide shoes are provided for replacement where there may not be space for roller guide shoes. They have removable gibs generally made of cast iron, although gibs of bronze are available. The movable portion of the shoe has a spindle which fits into the supporting bracket and permits the shoe to adjust itself to the rail. An adjusting spring acts as a buffer to take up variations in the rail and reduce side sway of the car. The gibs of the 10-, 13-, and 18-inch shoes are in three pieces, individually spring-backed.

U. ROPES

Westinghouse hoist ropes are of high-grade traction steel specially designed for elevator service. Rope diameters generally range from a minimum of one-half inch to a maximum of three-fourths inch. Stranding is 6 x 19 or 8 x 19, depending on the size and use. The rope ends are turned back, seated, and babbited into forged shackles.

V. COMPENSATION

In general, compensation for the weight of the hoist ropes is not necessary when the elevator travel does not exceed 100 feet. Compensation for higher-speed elevators consists of rope fastened to the underside of car and counterweight and passing under a weighted sheave in the pit. For lower-speed elevators, it is common practice to use chains interwoven with sash-cord and fastened securely to the underside of car and counterweight.

W. SIGNAL EQUIPMENT

All fixtures will be the Westinghouse standard square face plate design of polished stainless steel. However, special designs or other ornamental metals and finishes are available when specified.

***1. Lanterns** (figure 22) **and Pushbuttons** (figure 23).* Lanterns are designed to provide maximum visibility from all angles. Lenses provide both front and side illumination, making them particularly suitable for use where a row of elevators is installed.

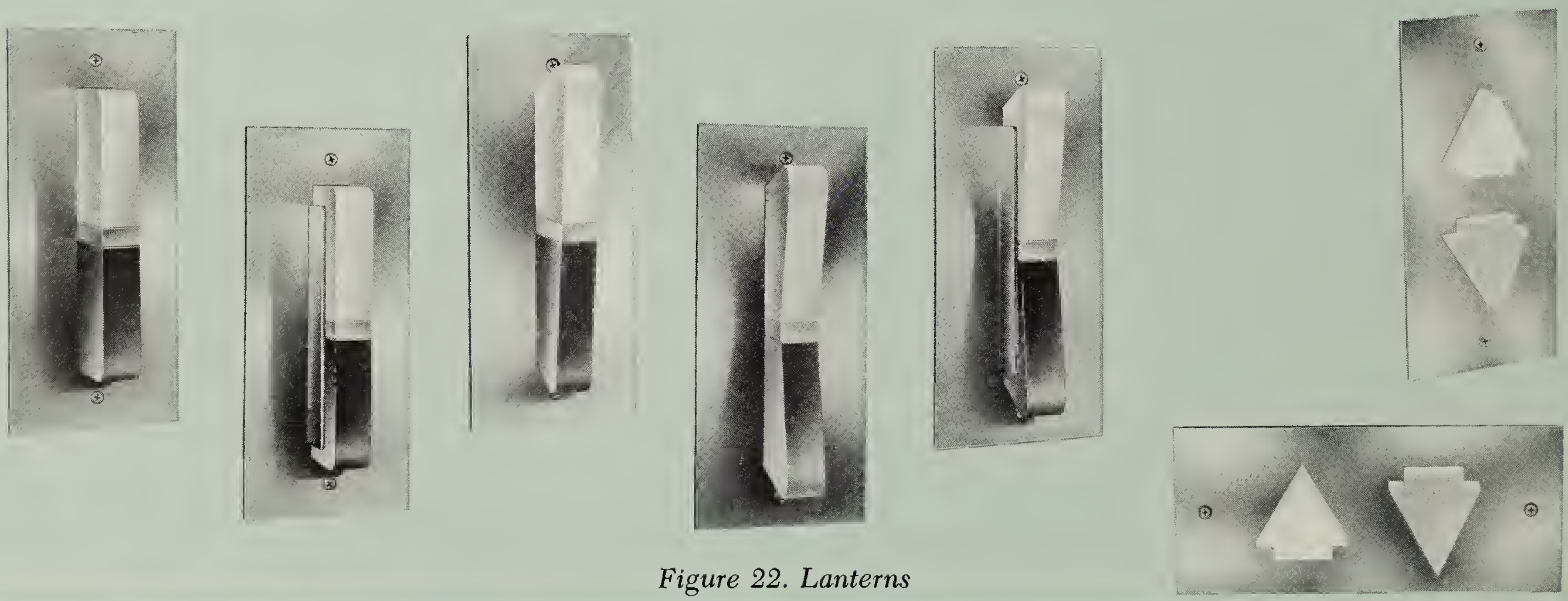


Figure 22. Lanterns

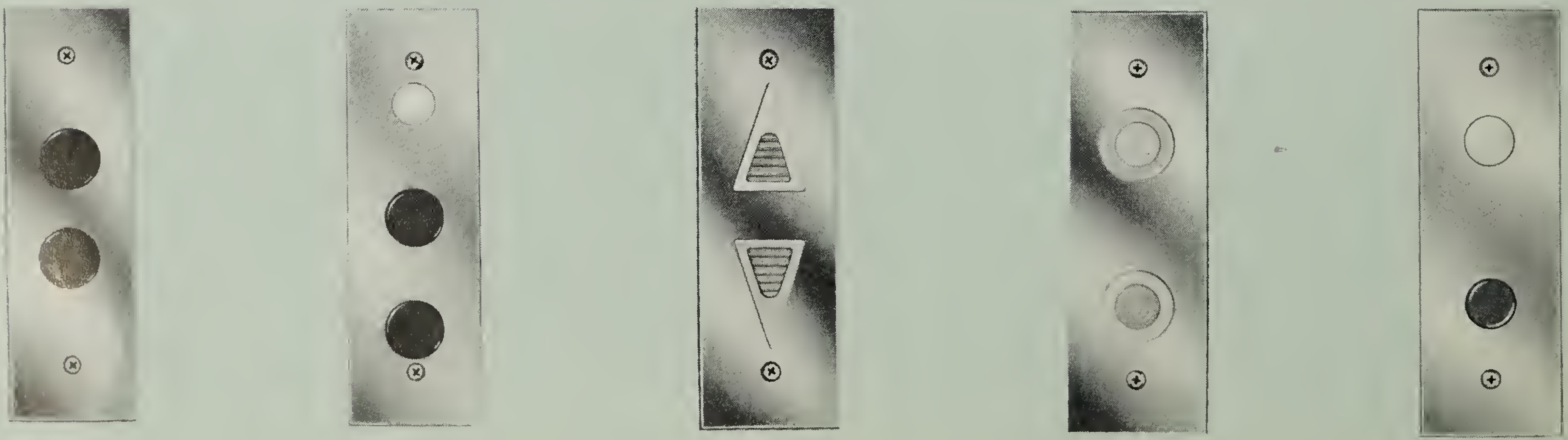
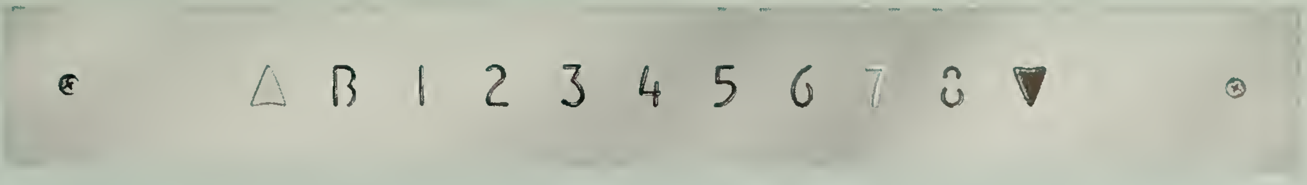
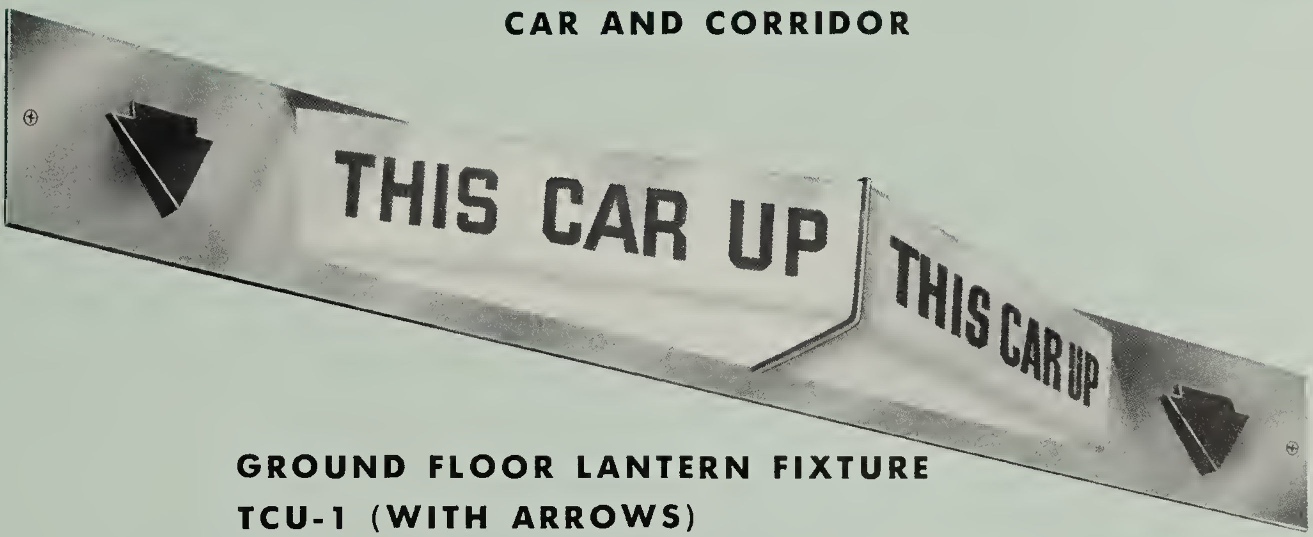


Figure 23. Pushbuttons



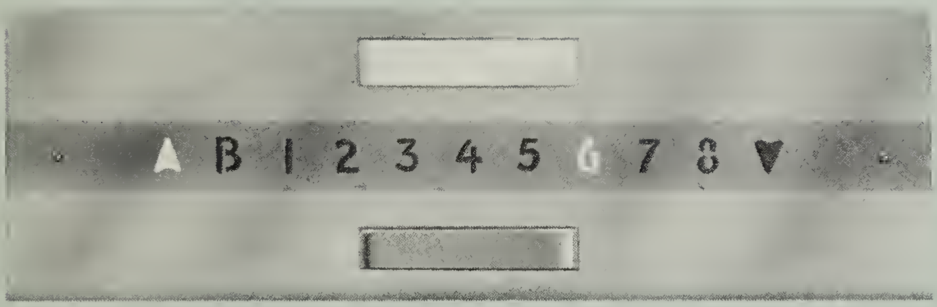
CAR AND CORRIDOR

Figure 24. Position Indicator



GROUND FLOOR LANTERN FIXTURE
TCU-1 (WITH ARROWS)
TCU-2 (WITHOUT ARROWS)

CORRIDOR
COMBINATION 1



COMBINATION 2

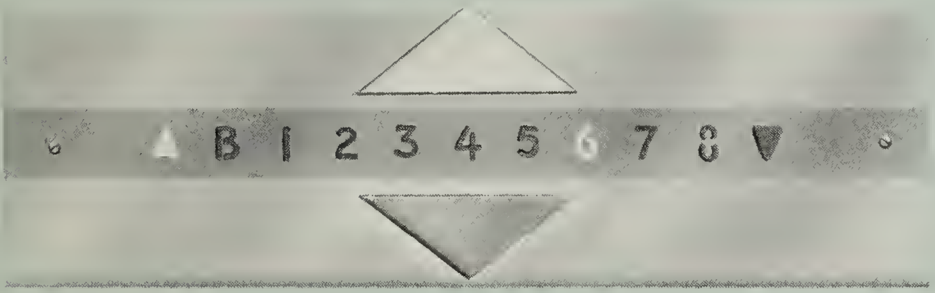
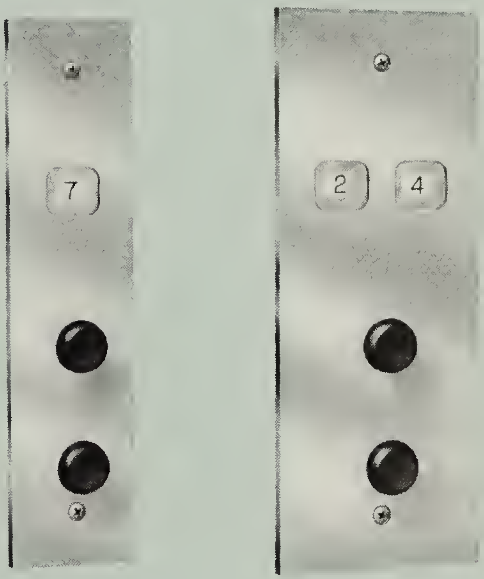


Figure 25. Combination Lantern and Position Indicators

Figure 26. Synchro-Dial Indicators



SINGLE-CAR INDICATOR **TWO-CAR INDICATOR**

The appearance of these fixtures will harmonize with any interior building design. An audible signal can be furnished, when specified, to sound at the instant the fixture is illuminated. Pushbutton fixtures of the indicating or non-indicating type are provided to match the lantern design for the most pleasing appearance.

2. ***Position Indicators*** *(figure 24).* These may be used in both car and corridor to indicate the position of the car. The lights are illuminated as the car travels through the hoistway by contacts on the selector. An individual light shield for the lamp of each numeral is fastened to the rear of the face plate. The lamps have a bayonet base to insure permanent connections and to make re-lamping simple. The surfaces of the injected plastic numerals and face plate are flush, thus eliminating dirt-collecting crevices. The numerals are of a size to be clearly visible, being three-fourths inch high. The face plate is simple and dignified in appearance and is available in a number of standard finishes. Directional arrows may be included to indicate the direction the car is traveling.

3. ***Combination Lantern and Position Indicators.*** These fixtures are available in combinations as shown in figure 25. Illuminated signs indicating the floors served may also be included.

4. ***Synchro-Dial Indicators*** *(figure 26).* These are miniature position indicators combined with a pushbutton station for one, groups of two or three elevators. They operate from the floor selector and thus eliminate ropes or metal tapes and minimize maintenance.

Types of Elevator Control

A. TYPES OF CONTROL

*1. **General.*** Two basic types of control are used with Westinghouse passenger elevators: the Variable Voltage, Synchro-Glide type with a direct-current driving motor, and the A-C Rheostatic type with an alternating-current driving motor. The type chosen depends on the service requirements of the installation. In each case, refinements of supervisory control are added to form the complete control system. Standard passenger elevator control systems are designed primarily for use with three-phase, sixty-cycle, alternating current, at 208, 220, or 440 volts. Provision can be made, however, for operation at other voltages and frequencies.

1. Variable Voltage Synchro-Glide Equipment *(figure 27)*. This type is the more flexible and is to be preferred. It includes a motor generator set for each elevator. The speed of the elevator is controlled by varying the field of the d-c generator which, in turn, varies the voltage impressed on the d-c hoisting motor. Variable voltage control eliminates rheostatic losses and allows accurate regulation and control of the elevator at all speeds including the low landing speed. It accomplishes this by automatically adjusting for temperature and elevator load so as to maintain the predetermined speed pattern. It allows a wide range of speeds up to that required for the tallest structures, yet it permits accurate, smooth stops and rapid acceleration and deceleration for all speeds. Power consumption and maintenance are minimized. Automatic leveling is always furnished with variable voltage control to compensate for rope stretch.

a. ROTOTROL *(figure 27)*. Rototrol, the "brain" of Synchro-Glide, depends on a source of power which may be either a small d-c generator (G) or an electronic unit which automatically regulates the elevator motor speed. The fields (A and B) are sensitive to the speed at which the car is operating and they consequently determine the voltage output of the d-c generator (G) which operates in the bridge circuit. This voltage through field (C) determines the strength of the main generator field which automatically corrects for any deviation from a predetermined speed pattern.

2. Rheostatic Equipment *(figure 28)*. The a-c rheostatic type of equipment is suitable for low-speed, low-rise application where the elevator is used infrequently and where it is necessary to limit the investment in the equipment. Whenever the normal landing accuracy of the a-c rheostatic type of equipment is not adequate, one of two special features may be used to increase landing accuracy.

a. AUTOMATIC LEVELING. This feature requires a two-speed elevator motor and control apparatus, and is available only with selective collective or single automatic control operation at speeds up to 100 feet per minute.

b. INCHING. "Inching" may be added to the controller for a single-speed a-c motor at nominal cost. It permits moving the car to floor level within a limited zone of approximately nine inches above or below the floor, with the doors open.

B. METHODS OF OPERATION

1. Single Automatic Control. This is a relatively simple control. The operating equipment consists of a car station containing a series of buttons correspondingly numbered to the floors served. In each corridor is a corridor call button station. A registered car call takes precedence over a corridor call. The system will "remember" only one call at a time and will not collect a series of calls. The car and hoistway doors are power operated and open and close automatically. This control should be used only on relatively inactive elevators of short rise.

2. Selective Collective Control. This control is generally used in apartments, hospitals, and small office buildings, where the service is light and where an operator is not necessary to direct and guide the passengers. It is available for groups of 1 to 3 cars. The car or cars will respond automatically to the pressure of a car or corridor button. Calls will be answered as the car travels up and down the hoistway. The car will automatically reverse at the highest and at the lowest call. A keyed switch may be provided so that the car or cars can be operated with an attendant when desired.

a. SINGLE-CAR TWO-BUTTON COLLECTIVE CONTROL

(1) Westinghouse single-car two-button collective control will operate in response to calls registered by pushbuttons in the car and corridors. "Up" and "Down" pushbuttons are installed at each intermediate corridor floor, and single buttons at the terminal floors. The momentary pressure on any button in the car or corridors will start the car in its proper direction of travel. Any number of calls may be registered and maintained at one time. A car traveling up will answer all registered car and up corridor calls, stopping automatically at the floors for which or at which a button has been pressed, until no further calls remain beyond the position of the car. Similarly, in the down direction it reverses at the lowest call. The stopping of the car will automatically cancel the call for that floor. When the car stops, a timing arrangement will automatically hold the car at the floor a sufficient time for the person entering the car to register a car call. The car will re-

main at the floor where the last call was answered and will start again only when another call is registered. If equipped with power-operated doors, the doors will open while the car is landing and remain open until the time allowed for passengers to enter the car has expired. If no car or corridor call is registered within that time, the doors will close.

(2) When the car has cleared all calls, the motor generator set will automatically stop after a predetermined time if, during that time, no calls are registered. Pressure of a corridor button will automatically start the motor generator.

b. TWO-CAR AND THREE-CAR TWO-BUTTON COLLECTIVE CONTROL *(figures 29, 30).*

(1) In each car there is a series of pushbuttons numbered to correspond to the various landings. At each intermediate landing there is a single up-and-down button fixture, and there are single buttons at the terminal landings.

(2) One of the cars is a "free" car which parks with its doors closed at the floor of the last call. The other car (or cars) park at the ground floor with the doors closed.

(3) Pressure of a corridor button at the floor where a car (or cars) is parked will cause the doors of a car to open.

(4) The supervisory system directs the cars so that calls are registered in the car most apt to answer the call. Calls are answered by the cars that will give the quickest response to the calls.

(5) After the calls are answered, the motor generator sets will stop. Pressure of a corridor button will automatically start the motor generator of the car to answer the call.

(6) If, for any reason, a car fails to start in answer to a corridor call, it will be automatically cut out of the system and another car will start to answer the call.

3. Selectomatic-Automatic Control *(figs. 31 to 35a).* Westinghouse Selectomatic-Automatic is an elevator supervisory system which automatically coordinates the operation of a bank of elevators and distributes service to all floors in an efficient and uniform manner as different traffic conditions arise, wholly without elevator attendants. In this manner, annual savings, in wages, uniforms, social security taxes, etc. amounting upwards to $7,000.00 per car are realized.

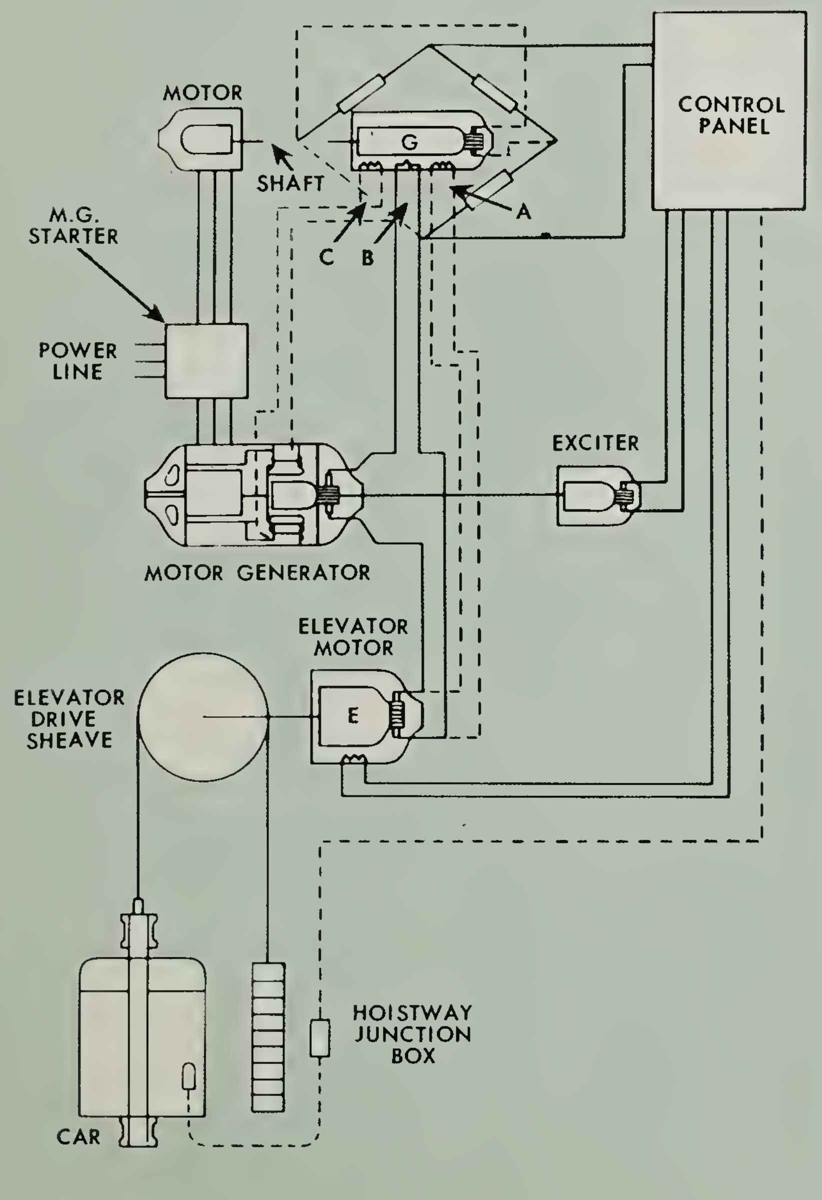


Figure 27. Schematic of Variable Voltage Rototrol Equipment

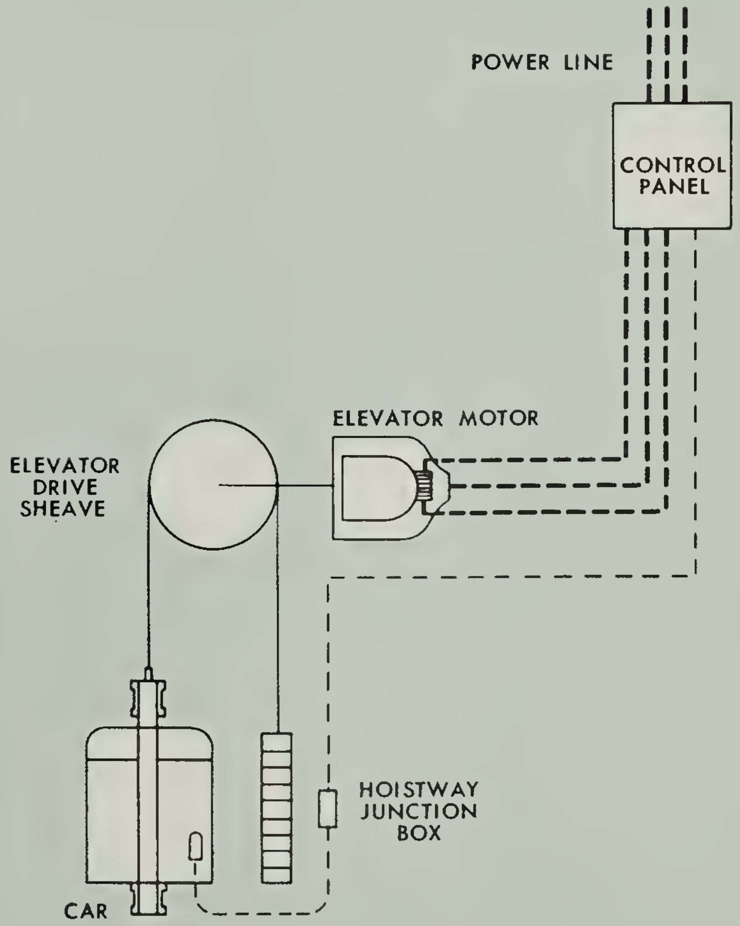


Figure 28. Schematic of Rheostatic Equipment

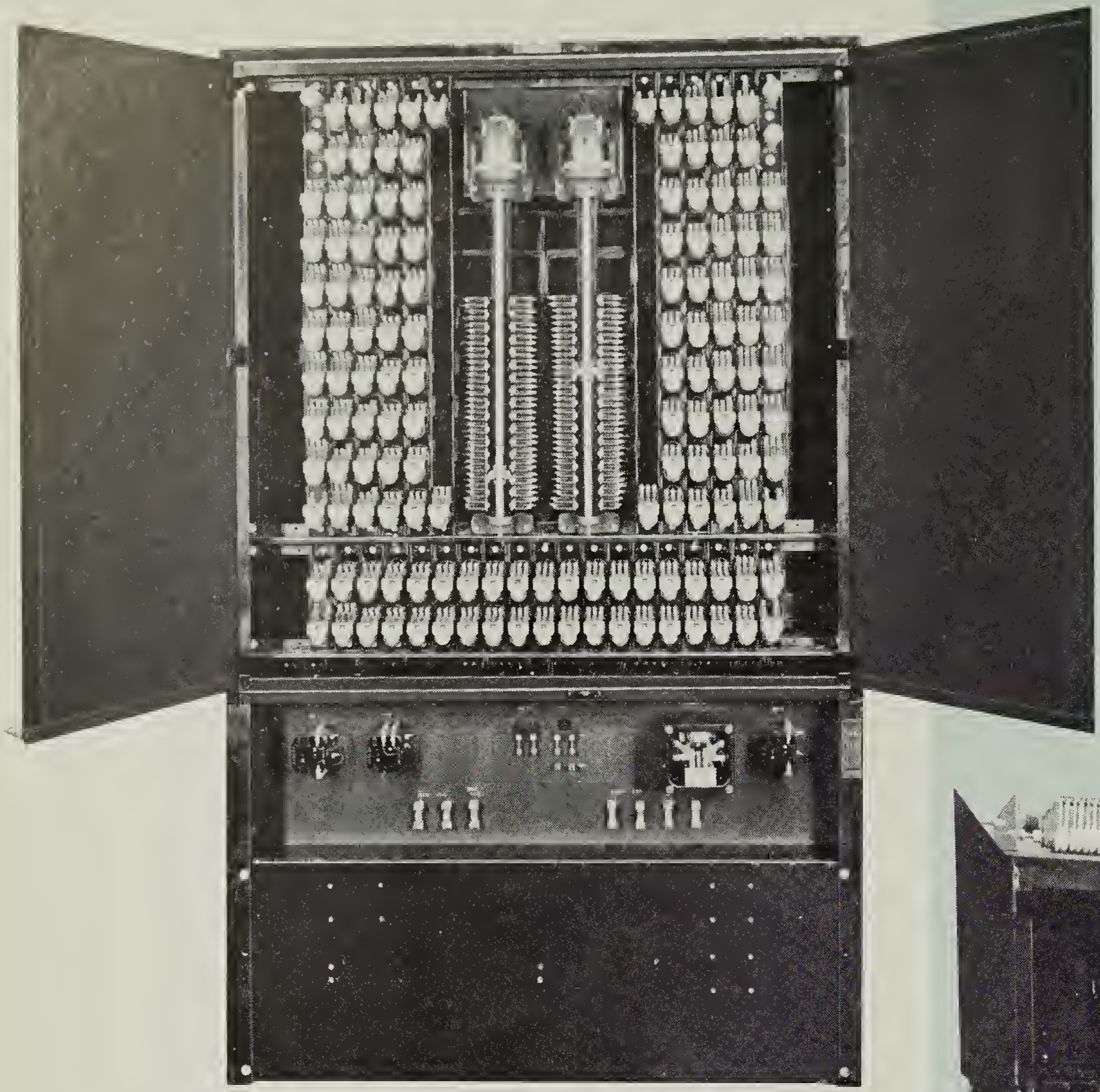


Figure 29. Relay Selector Panel

TWO CAR TWO-BUTTON COLLECTIVE CONTROL EQUIPMENT (VARIABLE VOLTAGE)

Selectomatic-Automatic is a distinctive Westinghouse development and is applicable to office buildings, hotels, apartment houses, hospitals and department stores. Traffic conditions vary widely in different types of buildings as well as at different times of the day. Therefore, the ideal supervisory system is one that will adjust itself quickly and automatically to meet such varying demands.

Westinghouse Selectomatic-Automatic, with Automatic Traffic Pattern, attains this ideal system better than any other. Because of its unique ability to adjust itself instantly and automatically to constantly changing traffic conditions, it provides the shortest interval (waiting time), the most uniform service to all floors, and the fastest round-trip time of any supervisory system.

In the majority of buildings, four basic types of traffic conditions are usually encountered. 1. Up-Peak—this condition exists when traffic is predominantly incoming, as in the morning. 2. Off-Peak—this condition prevails during the greater part of the day. 3. Down-Peak—this condition exists as passenger traffic becomes preponderantly outgoing, as in the evening. 4. Off-Hours—this condition exists during nights and on Sundays and holidays when little or no traffic exists. (Figure 35a.)

The proper control pattern (Up-Peak, Off-Peak, Down-Peak, Off-Hours) to most efficiently handle the traffic demand, may be selected automatically by the "Automatic Traffic Pattern" control system (see page 26) or may be selected manually by the Traffic Director.

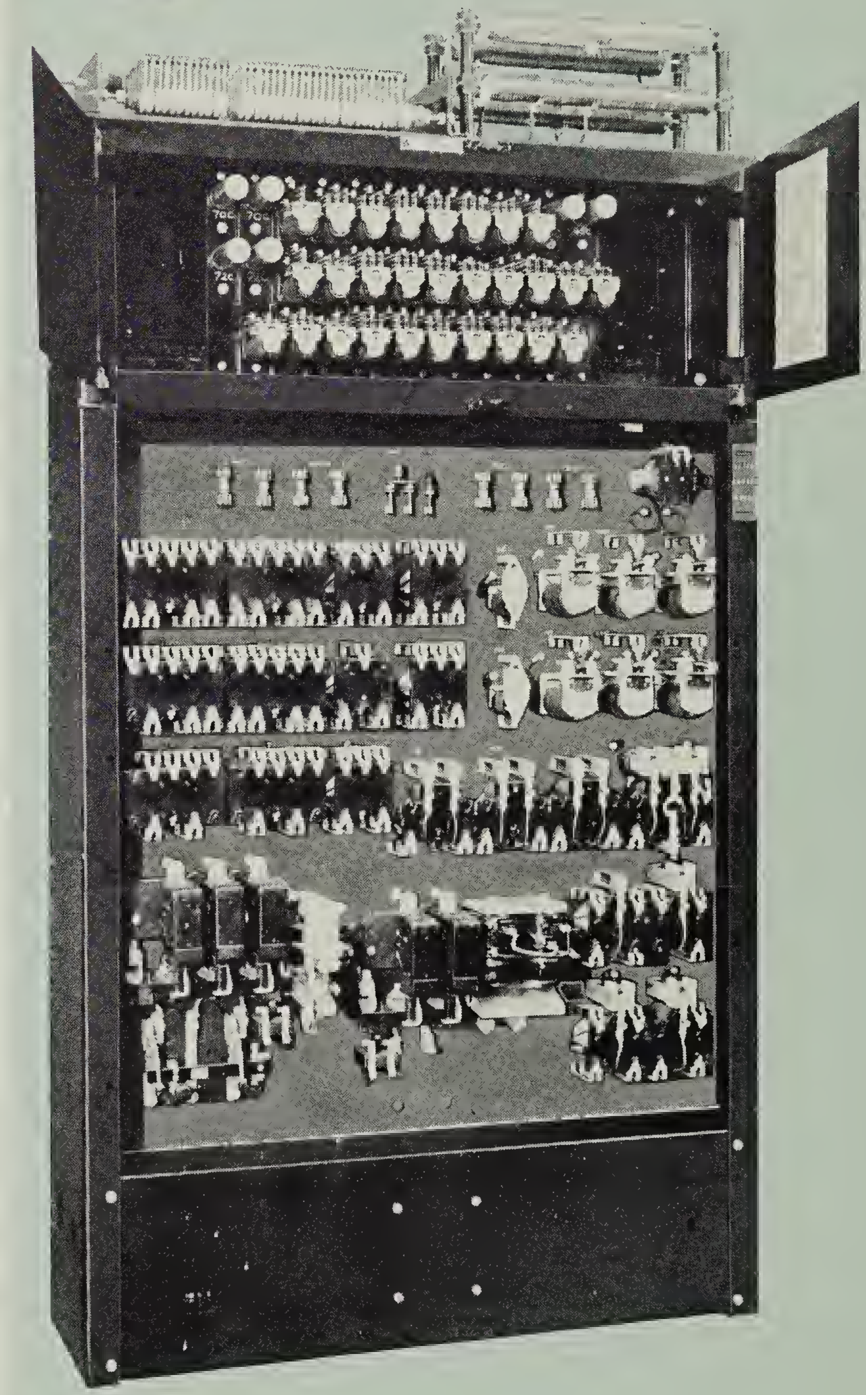


Figure 30.
Control Panel

UP-PEAK

All cars operate as a group and serve all floors.

Cars receive their start signal at automatically adjusted intervals at the lower terminal but not necessarily in numerical sequence. Cars leave the lower terminal as they become available.

Cars reverse immediately after the highest registered car or corridor call has been answered.

If there are not enough passengers to load a car to capacity, a car may be held at the lower terminal beyond its normal interval to accommodate additional passengers until another car is available.

Should a car become loaded before the interval has elapsed it will receive its start signal and depart.

If, during a temporary traffic lull, the cars should tend to bunch at the lower terminal then a Start Sooner feature automatically shortens the interval thereby counteracting the bunching.

OFF-PEAK

Because of the varying demands of traffic during the Off-Peak period, which prevail during the greater part of the day, Selectomatic-Automatic provides a flexible Off-Peak pattern which responds to the constantly changing traffic: Balanced, Heavier-Up, Heavier-Down and Heavy Down. It is unerring in its accuracy and entirely automatic.

Balanced traffic occurs when the movement of passengers is approximately equal in both directions. Cars are uniformly spaced and travel up and down with a uniform interval. Should the traffic increase or decrease equally in both directions, an automatic increase or decrease in the interval is effected.

Heavier-Up traffic requires the cars to make more stops in the up direction. Selectomatic-Automatic adjusts the interval automatically, permitting more time for the up travel. The interval adjusts itself so that the cars are equally spaced in time reducing passenger waiting time at all floors to a minimum.

Heavier-Down traffic requires the cars to make more stops in the down direction. Selectomatic-Automatic adjusts the interval automatically, permitting more time for the down travel. The cars are again equally spaced in time.

Heavy-Down traffic automatically places the system in a Heavy-Down operation when the preponderance of calls is in the down direction. During this period the cars operate with a High-Call Reversal feature, whereby the cars reverse automatically at the highest car or corridor call. Should the number of calls decrease appreciably, the system continues operating on Heavy-Down except the High-Call Reversal feature is eliminated thereby permitting the cars to travel to the top terminal.

DOWN-PEAK

Selectomatic-Automatic, during the Down-Peak pattern, provides equal service to all floors in both the upper and lower sections of the building by dividing the elevators into two groups—a high zone and a low zone. The zoning markedly reduces the round-trip time of each car by reducing the number of stops.

The high-zone and the low-zone cars function independently but will lend mutual assistance to cars in the other zone as traffic demand warrants.

The separating floor between the two zones is known as the Load Center and is governed by the demand for service in the two zones. The Load Center will "float" up or down to assure equal service as required in the high zone or the low zone.

All cars are assigned a quota of calls in accordance with the particular building's requirements. If a car's quota of calls is not filled it will travel into the other zone in response to corridor calls.

If calls in either of the lower sections of the high and low zones have gone unanswered for a predetermined time, Selectomatic further divides the zone into two auxiliary zones. The car will then travel up to the highest call in the auxiliary zone in answer to the calls that have been waiting.

OFF-HOURS

The Off-Hours pattern provides the most efficient operation during that period of the day and on Sundays and holidays when little or no traffic exists.

If no calls exist, all cars park at the lower terminal with their motor generators shut down.

One, two or any number of elevators can be assigned to Off-Hours service by individual control buttons.

When a demand for service is made, only one car will respond to the call. However, should the demand continue after the first car has departed, another car or cars will be automatically placed in service. Cars remain in service only as required.

In order to provide efficient and dependable operation and to gain complete acceptance by the elevator passenger, the following

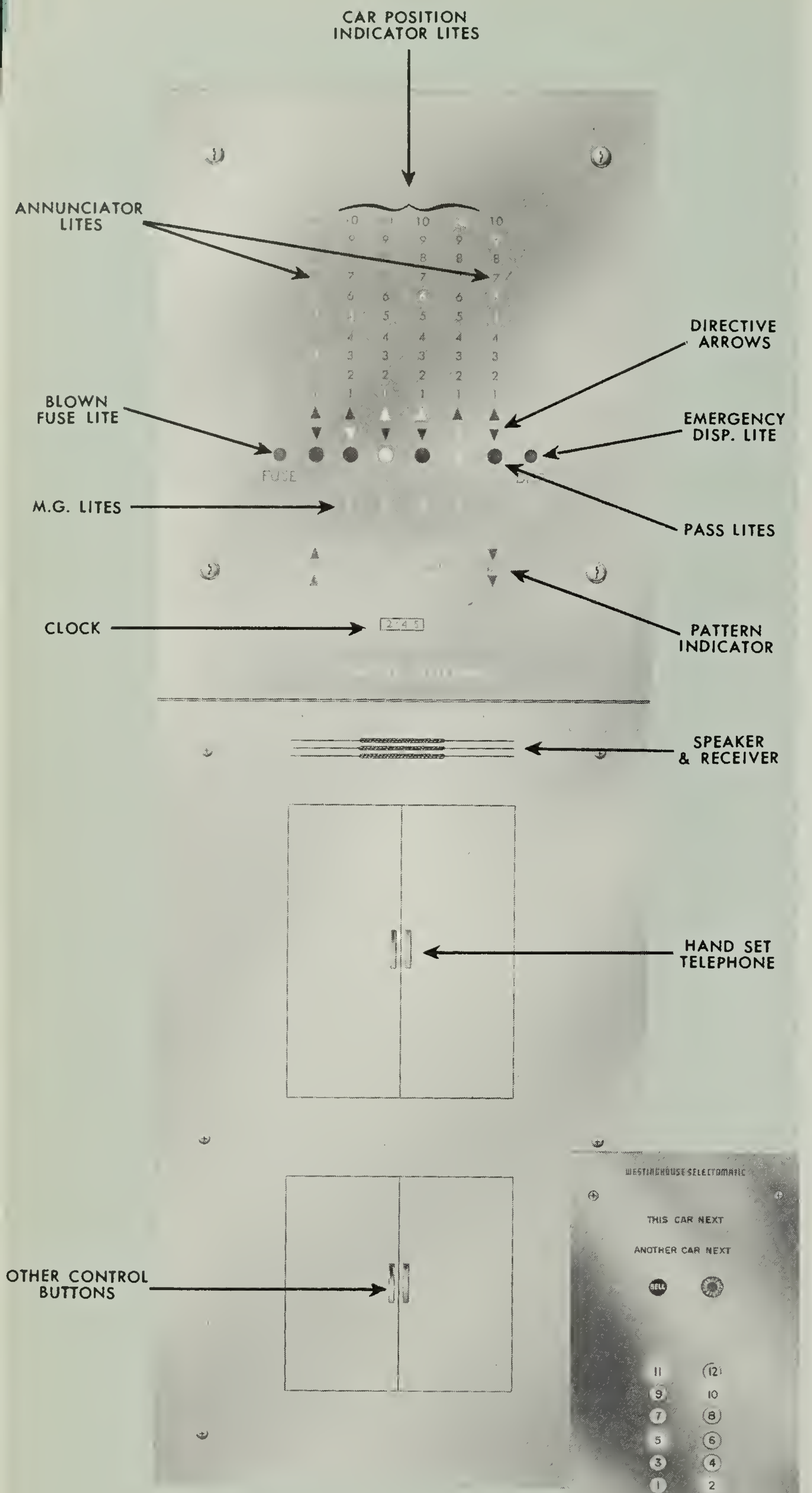


Figure 31. Position and Motion Indicator Panel and Traffic Director's Panel for Selectomatic-Automatic Control with Automatic Traffic Pattern

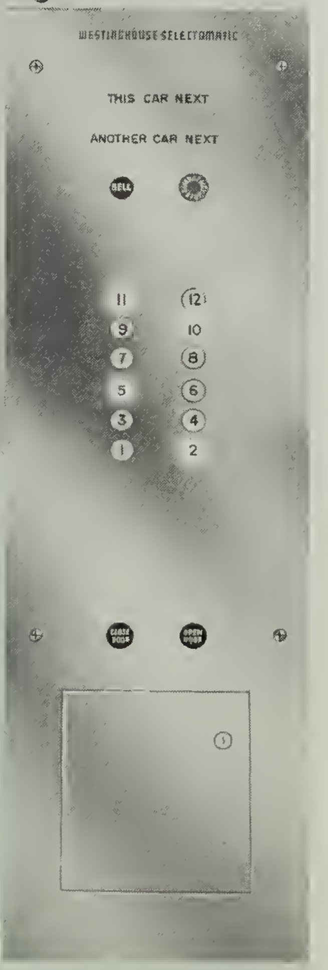


Figure 32. Car Station with Illuminated Floor Buttons

features are incorporated in the Selectomatic-Automatic system:

The doors open and close automatically. However, for maximum passenger comfort the closing power and speed are reduced.

Car doors are equipped with a Westinghouse Saf-T-Edge mounted on the leading edge of the door or doors. Should the doors be closing while a passenger is passing through the entrance, a light touch on the Saf-T-Edge will re-open the doors.

Should a car fail to start within a predetermined time, it is taken out of service automatically.

All loaded cars will by-pass corridor calls automatically.

Over the entrance of each car and on every floor a hall lantern will be supplied.

In case of overspeed or tripping of the overload relay the car will stop at the next floor. In addition, if the car is fully loaded the doors will not open until the car is at floor level.

One or more cars may be arranged to travel to the basement or above the top terminal.

A car position indicator fixture will be located in the car.

The car station will have two signs which will illuminate when a floor button is pressed indicating to the passenger whether that car or another is next to leave.

During the Off-Hours pattern, the motor generator set of those cars without a start signal will shut down automatically.

During the Down-Peak pattern, should an up-going passenger enter a low zone car by mistake, the car will respond to the call.

In event of failure of the dispatching system, dispatching of the cars is transferred to an auxiliary system.

Should the power supply to the common signal panel fail it is replaced automatically by an auxiliary supply.

If the corridor buttons become inoperative due to a power supply failure, the button circuit is transferred to an auxiliary supply. However, should the auxiliary supply fail, cars stop automatically for calls according to a predetermined pattern.

AUTOMATIC TRAFFIC PATTERN

Traffic controlled Selectomatic truly matches elevator performance to traffic demand. It assures tenant and passenger ultra-modern vertical transportation . . . twenty-four hours a day! By means of its electronic measuring and computing, it anticipates and changes the system instantly from one operating pattern to another automatically.

In buildings such as occupied by a single tenant a timing device can be provided so that a particular operating pattern may be anticipated and selected automatically for a predetermined time of day.

The Traffic Director, if employed, is free for information and good will activities.

TRAFFIC SENTINEL *(figures 33 and 34)*

Westinghouse Traffic Sentinel consists of a Saf-T-Edge, a photo-tube and suitable control circuitry. The Traffic Sentinel for operatorless elevators is a device which monitors and initiates door closing to conform with traffic movement.

The door-open time is no longer fixed but is adjusted automatically to the number of passengers entering and leaving the elevator car. Traffic Sentinel affords maximum convenience to passengers. Doors will not annoy passengers since the doors will not start to close while a person is in the entrance; doors will re-open immediately if a person enters the entrance after the doors have started to close.

COMMUNICATION SYSTEM

a. An Intercommunication system can be furnished to provide communication between passengers and the Traffic Director or other responsible person.

b. In one or more cars a Bell Telephone System may be provided for out-of-the-building communication.

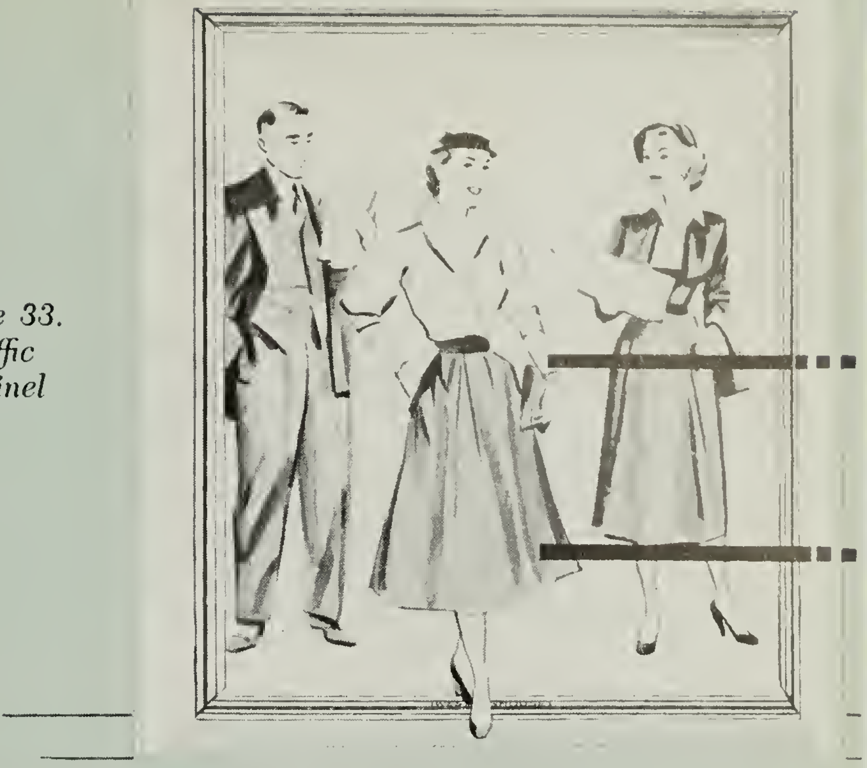


Figure 33. Traffic Sentinel

Figure 34. Saf-T-Edge

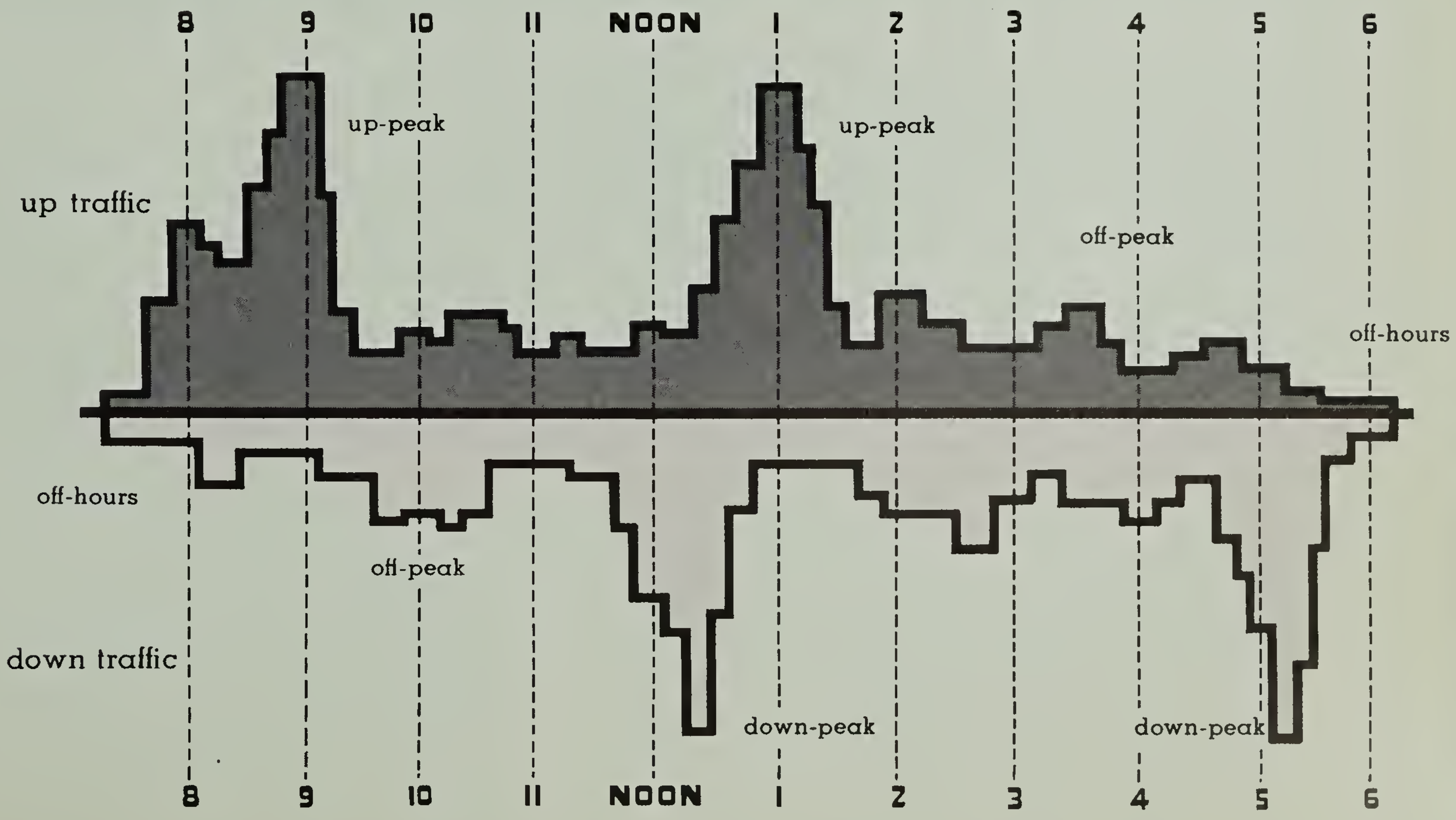


Figure 35a. Typical Office Building Traffic Count

How to Select Passenger Elevators

A. GENERAL

1. The elevator installation in any building has been properly selected if it economically satisfies the requirements of the tenants.

2. A traffic study is essential to determine the economical number, characteristics, and grouping of an elevator installation.

B. TRAFFIC STUDY

1. General. All traffic studies are based on certain factual information concerning a given building and on a number of consequent determinations.

a. FACTUAL INFORMATION. The following data must be noted:

(1) *Building Characteristics.*
- Number of floors
- Floor heights
- Travel (distance from main terminal to top floor)
- Location

(2) *Population.* The characteristics of the building population are basic to a traffic study and must be ascertained.

b. DETERMINATIONS. There are three facts which must be determined by a traffic study before recommendations of a suitable passenger elevator installation may be made for various active periods:

(1) The average round-trip time
(2) The interval
(3) The passenger-carrying capacity of the system

2. Average Round-Trip Time. The determination of the round-trip time of an elevator is the first problem of any traffic study. It assumes knowledge of the characteristics of the particular building, and of elevator capacities, speeds, and types of control; and it involves careful and detailed calculations.

a. DEFINITIONS. The following definitions will clarify the problems involved:

(1) *Round-trip time* is the sum of the running time, the door time, and the passenger time.

(2) *Running time* is the sum of acceleration time, deceleration time, and time at rated speed. It depends on the rated speed of the elevator, the number of stops, the average jump, and on the characteristics of the elevator.

(3) *Number of stops* is the probable number of stops plus the necessary terminal stops. The probable number of stops depends upon the number of passengers and the number of floors served by the elevator.

(4) *Average jump* is the distance in the local zone divided by the probable number of stops the elevator will make.

(5) *Door time* is the actual time used by the doors in motion while the elevator is at rest. It excludes the time required for the partial opening of the doors while the elevator is in motion in the landing zone.

(6) *Passenger time* is the total time required by the passengers entering and leaving the elevator during a round trip. It varies with the size of door opening.

b. CURVES *(figures 35 to 38 inclusive).* To facilitate the determination of round-trip time, all the above calculations have already been made and the results are shown by the curves in figures 35 to 38 inclusive. From these curves it is possible to read the round-trip time for an elevator of a given capacity and speed. The following explanations will clarify their use.

(1) The curves may be used for the selection of the elevator system in all types of buildings except department stores. Each department store presents a unique traffic problem because of the use of electric stairways and the disbursement of merchandise, and therefore a generalization in the form of curves is not included in this Guide.

(2) Curves A to E inclusive are based on Selectomatic-Automatic control; curves G and H are based on two-button collective control.

(3) Curve F is applicable to any capacity elevator of both selectomatic or two-button collective control where express floors are a factor in the total round-trip time calculations.

(4) From the curves the round-trip time may be determined both for local and express zones. These curves include the running time, the door time, and the passenger time. Door time is based on power-operated doors of the type normally used for the sizes of elevators shown on the curves.

(5) The curves may be used to approximate the number of elevators required. Each application, however, should be checked more closely by a qualified elevator engineer who, with his experience, will take into consideration various conditions and special features of the control systems available.

3. Interval.

a. DEFINITION. The interval is the average time a passenger must wait for an elevator; or, in other words, it is the frequency at which the elevators leave the main terminal. It is expressed as the average round-trip time divided by the number of cars in a bank of elevators:

$$\text{Interval} = \frac{\text{Round-trip time}}{\text{Number of cars in bank}}$$

b. DESIRABLE INTERVAL. The interval desirable for adequate service depends on the type and location of building. It is not practical for the interval to be less than the time required to load one car at the main terminal plus the door time. (See Table I.) In many cities an interval of 20 to 25 seconds will be required. In others, an interval as high as 40 seconds may be satisfactory. Longer intervals are permissible only in hospitals, apartment houses, or buildings where one or two elevators will provide more than adequate passenger-carrying capacity.

TABLE 1

CAPACITY (Pounds)	MINIMUM INTERVAL (Seconds)
2,500	15
3,000	18
3,500	20
4,000	23

c. MINIMUM PRACTICAL INTERVAL. Table I shows minimum practical intervals for different capacity elevators.

4. The Passenger-Carrying Capacity of an Elevator System.

a. DEFINITION. The passenger-carrying capacity of an elevator system is expressed as the percentage of the building population that can be carried one way in a period of time, usually five minutes. The passenger-carrying capacity of department store elevators is generally expressed as the number of people that can be carried in one hour.

b. PASSENGER CAPACITY TABLE. Table II lists nominal passenger capacities. The passenger capacity in each case is generally determined by dividing the rated capacity of the elevator by 150, and subtracting one for the elevator operator. For traffic calculations, passengers per trip (normal peak) is assumed to be 80 percent of the elevator passenger capacity.

TABLE 2

ELEVATOR CAPACITY (Pounds)	PASSENGER CAPACITY	PASSENGERS PER TRIP (Normal Peak)
1,200	7	6
2,000	12	10
2,500	16	13
3,000	19	16
3,500	22	18
4,000	26	21

c. FORMULA. To determine the passenger-carrying capacity of one car in five minutes, the following formula should be used:

$$\text{Passenger capacity per car in 5 minutes} = \frac{60 \times 5 \times \text{number of passengers per trip}}{\text{Round-trip time (seconds)}}$$

From Table 2, normal peak

SELECTOMATIC CONTROL

FLOOR HEIGHTS—12 FEET

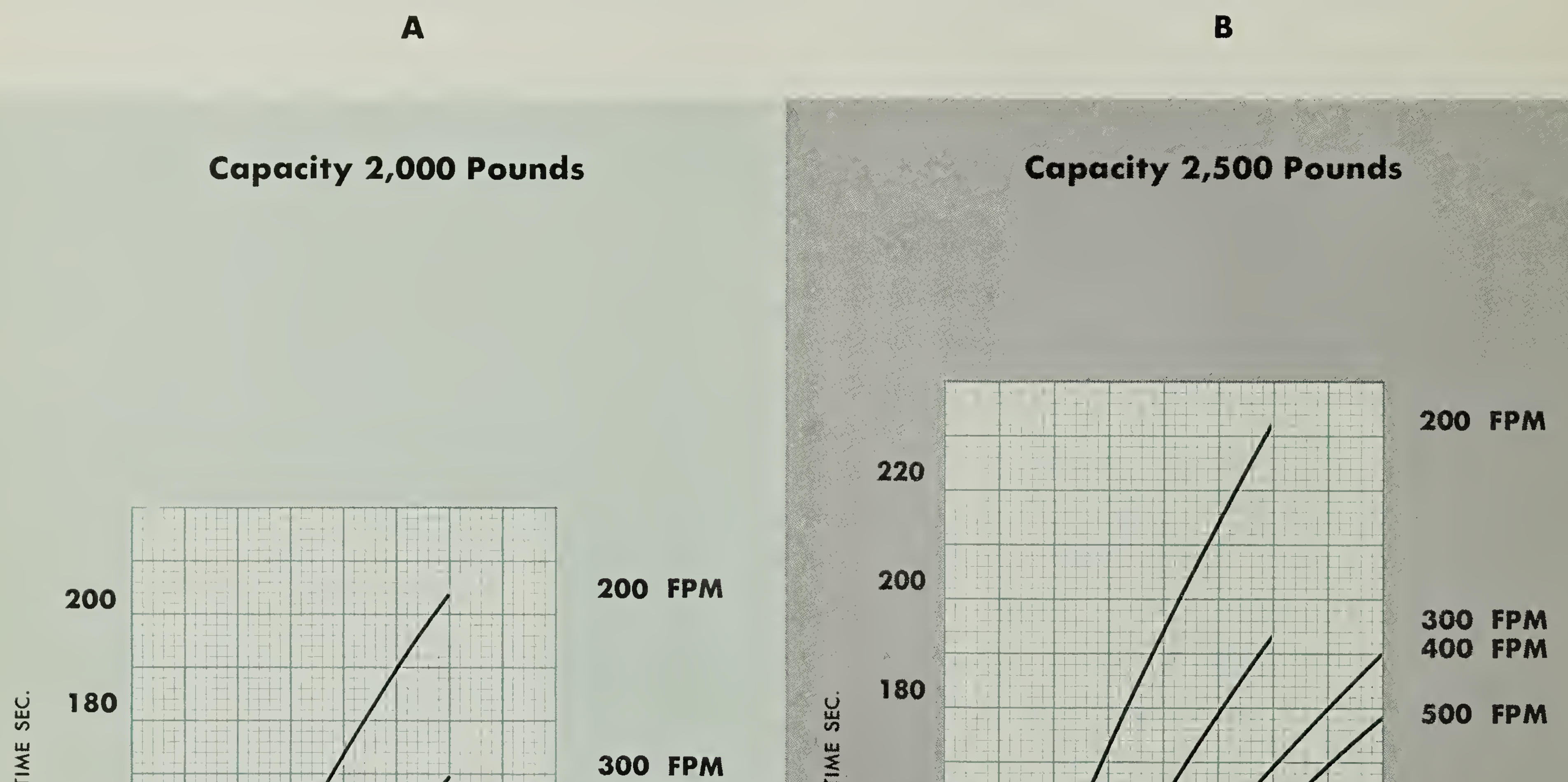
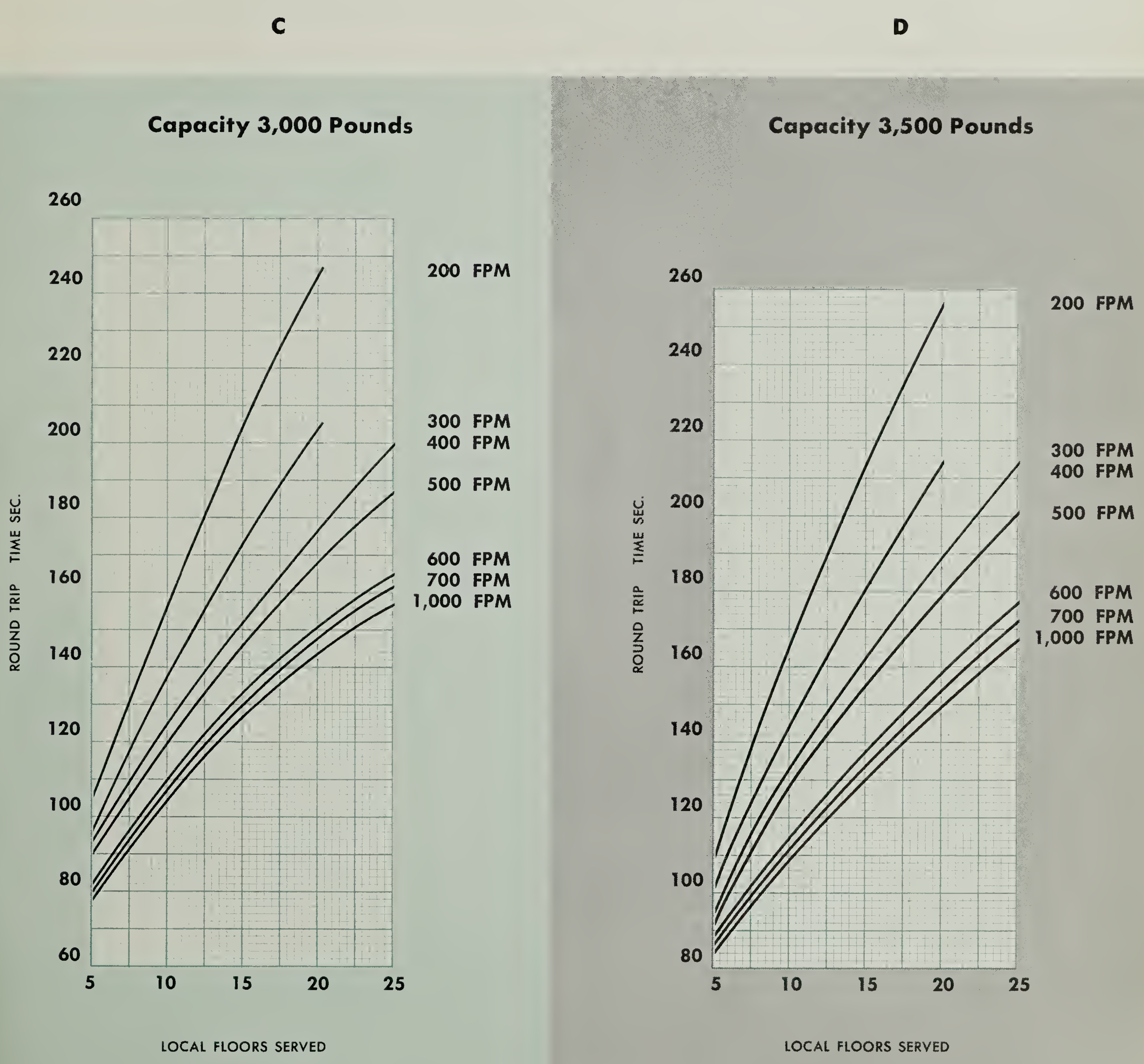


Figure 35. Average Round-Trip Time Curves

SELECTOMATIC CONTROL

FLOOR HEIGHTS—12 FEET



C — Capacity 3,000 Pounds

D — Capacity 3,500 Pounds

Figure 36. Average Round-Trip Time Curves

FLOOR HEIGHTS — 12 FEET

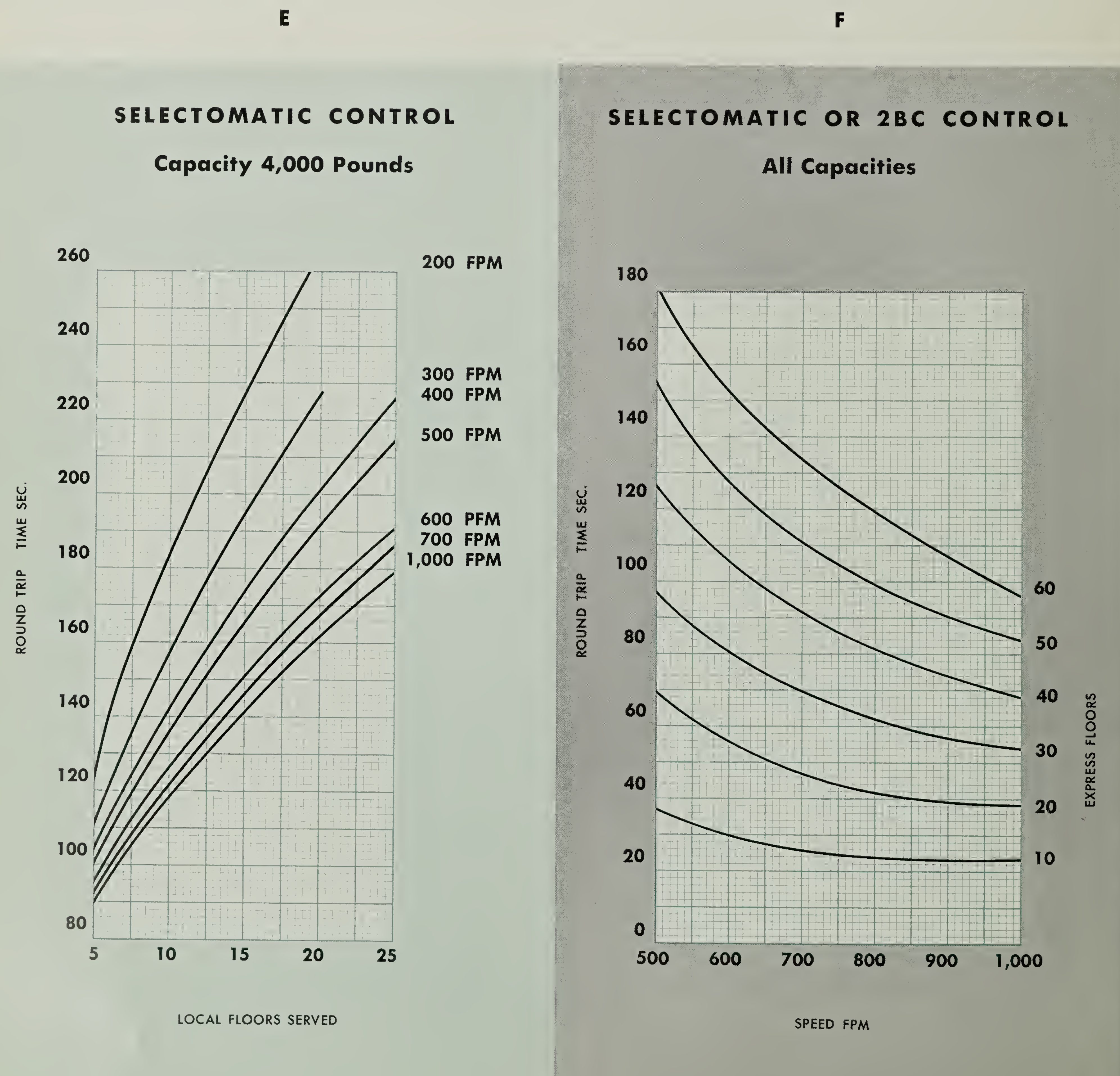


Figure 37. Average Round-Trip Time Curves

2BC CONTROL
FLOOR HEIGHTS — 12 FEET

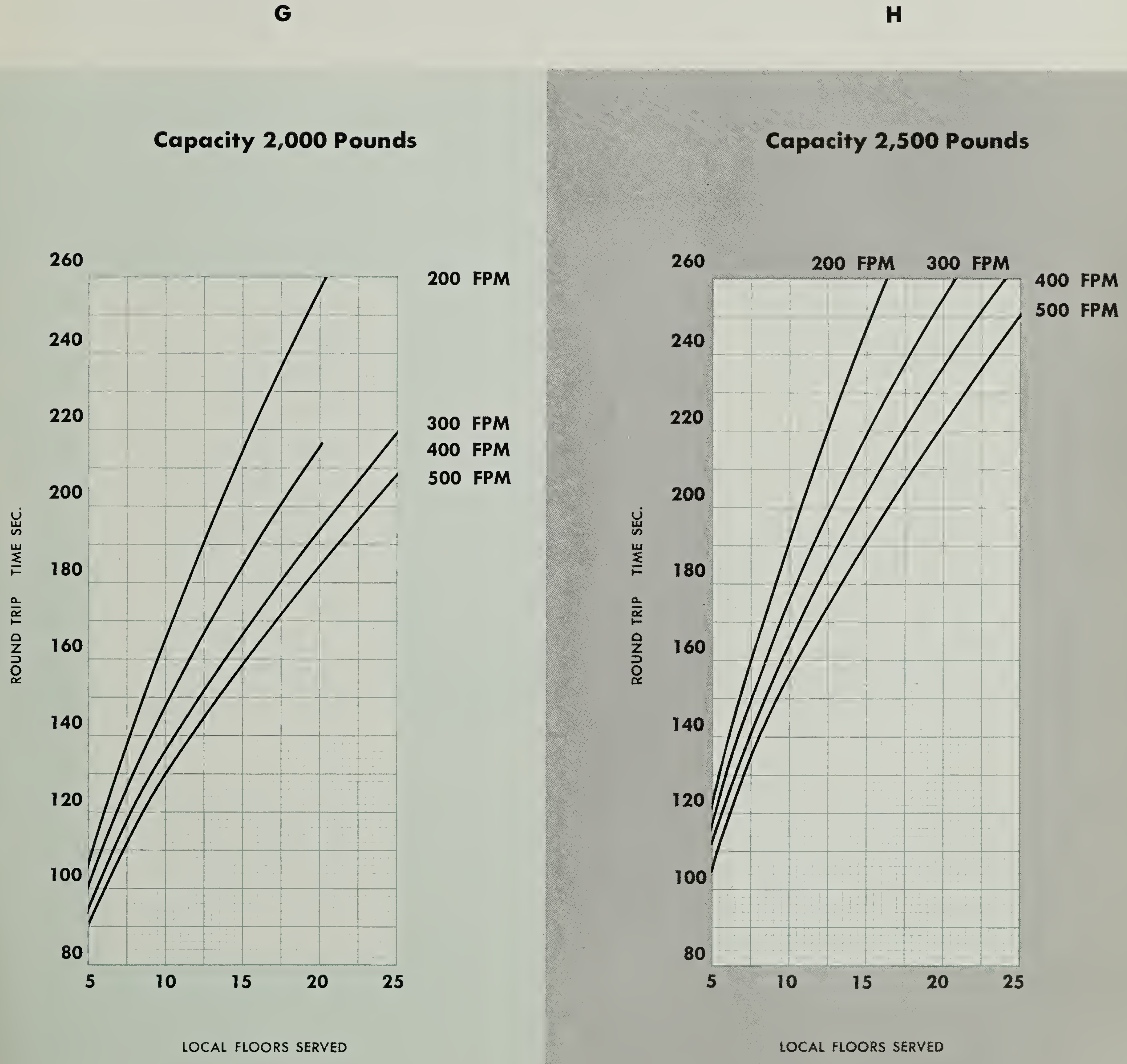


Figure 38. Average Round-Trip Time Curves

C. SELECTION OF PASSENGER ELEVATORS

1. General.

a. The previous discussion has been somewhat theoretical. It has not related the interdependence that exists between round-trip time, interval, and passenger-carrying capacity in the actual selection of passenger elevators for a particular building.

b. THE PROBLEM. The actual problem is the choice of the minimum number of elevators that will meet the required conditions. This means that the number chosen can carry a predetermined percentage of the population in five minutes and, at the same time, provide the desired interval. However, since there are various elevator capacities and speeds, and various combinations of these two, the solution of the problem is relatively simplified. Nevertheless, it involves a process of approximation of an ideal condition until the most economical system adequate to the existing traffic needs is found.

c. THE STARTING POINT. The starting point for any type of building is always the same. From past experience it is possible to know approximately how many people are to be carried in a given time, and what the interval should be. Subsequent calculations have these two ends in view.

2. Standard Passenger Elevator Tables. Tables III to VI inclusive are provided for use in making selections of standard passenger elevators on the basis of which traffic studies can be made.

3. Example. The following example, which illustrates the use of the curves and tables in this section, is provided as typical of traffic study calculations.

a. FACTUAL INFORMATION.

Type of building—Office
Number of floors—21 (20 above ground floor)
Floor heights—12 feet
Total travel—240 feet
Total population—2000
Maximum interval—30.0 seconds
Required passenger-carrying capacity — 13 percent of population in five minutes, or 260 people.

b. CALCULATIONS *(all elevators local).*

(1) Table III indicates that the minimum speed for a travel of 240 feet is 700 feet per minute, and that this speed is available with any capacity from 2500 to 4000 pounds. One of these capacities is chosen—3000 pounds, for example.

(2) Curve C, figure 39, indicates that the round-trip time for a 3000-pound, 700 feet per minute elevator, for 20 floors, is 148 seconds.

(3) Using the passenger-carrying capacity formula (page 29, paragraph B.4.c.):

$\frac{60 \text{ x } 5 \text{ x } 16}{148}$ (from Table II, for 3000-pound capacity),

it is ascertained that this elevator can carry 32.5 people in five minutes.

(4) Dividing 32.5 into the total number of people to be carried in five minutes—that is, 260 people—the result is that eight cars are required in the bank of elevators.

(5) By dividing the round-trip time (148 seconds) by the number of elevators (8), an interval of 18.5 seconds results. Table I indicates that the minimum interval for a 3000-pound capacity elevator is 18 seconds. *Eight 3000-pound, 700 feet per minute elevators are therefore one solution to the problem.*

(6) In a second attempt to solve the existing problem, a 4000-pound capacity elevator will be chosen.

(7) Curve E, figure 37, indicates a round-trip time of 168 seconds for this elevator, traveling 700 feet per minute, for 20 floors.

(8) Using the formula again:

$\frac{60 \text{ x } 5 \text{ x } 21}{168}$ (from Table II, for 4000-pound capacity),

the result is that one 4000-pound capacity elevator can carry 37.5 people in five minutes.

(9) By dividing 37.5 into the total number of people to be carried in five minutes (260), seven elevators are required.

(10) Dividing the round-trip time (168) by the number of elevators (7), an interval of 24.0 seconds results. Since Table I indicates a minimum interval of 23 seconds for a 4000-pound capacity elevator, it is obvious that a suitable interval has been found.

TABLE 3

OFFICE BUILDINGS, HOTELS, INDUSTRIAL BUILDINGS

CAPACITY (Pounds)	SPEED* (Feet Per Minute)	TRAVEL (Feet)	BASIC CONTROL AND TYPE OF MACHINE
2,000†	200	Up to 100	Variable Voltage Geared
	250	Up to 125‡	
2,500	350	Up to 150‡	
3,000	500	Up to 175	Variable Voltage Gearless
	700	Up to 250	
3,500	800	Up to 350	
4,000	1,000	Over 350	

*Speeds are recommended minimums for indicated travel.
†The highest recommended speed for this capacity is 500 feet per minute.
‡Gearless elevators at 400 to 500 feet per minute are frequently desirable for this travel.

TABLE 4

APARTMENT HOUSES

CAPACITY (Pounds)	SPEED* (Feet Per Minute)	TRAVEL (Feet)	BASIC CONTROL AND TYPE OF MACHINE
1,200	100	Up to 70	Rheostatic Geared
	200	Up to 100	Variable Voltage Geared
	250	Up to 125	
2,000	350	Up to 150†	
	400	Up to 175	Variable Voltage Gearless
	500	Up to 250	
2,500	700	Up to 350	

*Speeds are recommended minimums for indicated travel.
†Gearless elevators at 400 to 500 feet per minute are frequently desirable for this travel.

TABLE 5

HOSPITALS

CAPACITY (Pounds)	SPEED* (Feet Per Minute)	TRAVEL (Feet)	BASIC CONTROL AND TYPE OF MACHINE
3,500	100	Up to 70	Variable Voltage Geared
	200	Up to 100	
	250	Up to 125†	
	350	Up to 150†	
	400	Up to 250	Variable Voltage Gearless
	500	Up to 350	
4,000	700	Up to 175	

*Speeds are recommended minimums for indicated travel.
†Gearless elevators at 400 to 500 feet per minute are frequently desirable for this travel.

TABLE 6

DEPARTMENT STORES

CAPACITY (Pounds)	SPEED* (Feet Per Minute)	TRAVEL (Feet)	BASIC CONTROL AND TYPE OF MACHINE
3,000	200	Up to 100	Variable Voltage Geared
	350	Up to 125†	
4,000	400	Up to 175	Variable Voltage Gearless
5,000	500	Up to 250	
	700	Up to 350	

*Speeds are recommended minimums for indicated travel.
†Gearless elevators at 400 to 500 feet per minute are frequently desirable for this travel.

(11) The above calculations show the following elevator system to be a reasonable one: *Seven 4000-pound, 700 fpm, variable voltage, gearless, Selectomatic-Automatic, with Automatic Traffic Pattern control elevators.* This bank will carry 13 percent of the population of this building in five minutes, and provide an interval of 24.0 seconds.

(12) The cost of such an installation can be approximated by calculations based on the price curve, figure 36.

c. CALCULATIONS *(elevators local and express).*

Before the recommendations in paragraph b. (11) above is made, further calculations will be necessary to determine if using local and express cars will result in a better solution. Such a possibility should always be considered in any office building having 15 or more floors.

(1) Since the building under consideration has 21 floors, local cars will probably serve floors 1 to 12, and express cars probably floors 13 to 21.

(2) The elevator rating chosen for trial will be 2500 pounds, 700 fpm. Assuming that the population density of this building is uniform, the lower zone will have 1100 people and the upper zone 900 people. Assume that in each case 13 percent of the population must be carried in five minutes. The following calculations will be made:

(3) *Local Floors 1 to 12.*

(a) Curve B, figure 35, indicates a round-trip time of approximately 104 seconds for a 2500-pound, 700 fpm elevator, serving 12 floors.

(b) The total required passenger-carrying capacity is 13 percent of 1100 people, or 143 people in five minutes.

(c) Using the formula:

$\frac{60 \times 5 \times 13}{104}$ (from Table II, for 2500-pound capacity), the result is that one 2500-pound capacity elevator can carry 37.5 people in five-minutes.

(d) By dividing 37.5 into the total number of people to be carried in five minutes (143), the result it that 3.8 cars will be required.

(e) Dividing the round-trip time (104) by the number of cars (4), a 26-second interval results. (See Table I.)

(f) The above calculations make the following recommendation a reasonable one for the local floors: *four 2500-pound, 700 feet per minute, variable voltage, gearless, Selectomatic-Automatic, with Automatic Traffic Pattern control elevators.*

(4) *Express Floors (13 to 21).*

(a) The rating chosen for trial will be 2500 pounds at 700 feet per minute.

(b) The required passenger-carrying capacity is 13 percent of 900 people; or 117 people in five minutes.

(c) Curve F, figure 37, indicates a round-trip time of approximately 29 seconds for 13 floors express. Curve B, figure 35, indicates a round-trip time of 92 seconds for a 2500-pound, 700 feet per minute elevator, for nine local floors. Therefore, total round-trip time for the elevators in question is 92 + 29 or 121 seconds.

(d) Using formula:

$\frac{60 \times 5 \times 13}{121}$ (from Table II, for 2500-pound capacity), the result is that one such elevator will carry 32 people in five minutes.

(e) By dividing 32 into the total number of people to be carried in five minutes (117), the result is that 3.7 cars will be required.

(f) By dividing 4 into the round-trip time (121), an interval of 30.2 seconds results, which will be accepted as satisfactory. (See Table I, and paragraph C.3.a., page 29.)

(g) The above calculations make the following recommendation a reasonable one for the express floors: *four 2500-pound, 700 feet per minute, variable voltage, gearless, Selectomatic-Automatic, with Automatic Traffic Pattern control elevators.*

(5) There are now three acceptable solutions for the elevator requirements of this building. Before a final selection is made, however, the cost of each must be considered. (See figure 40, and the calculations in section V.)

(a) 8 cars, 3000-pound, 700 fpm, serving 1 to 21 floors	$ 818,400.00

(b) 7 cars, 4000-pound, 700 fpm, serving 1 to 21 floors 744,800.00

(c) 4 cars, 2500-pound, 700 fpm, serving 1 to 12 floors
4 cars, 2500-pound, 700 fpm, serving 13 to 21 floors........... 689,440.00

(6) *Final Recommendation.* Since the performance of two banks of four 2500-pound, 700 feet per minute elevators is satisfactory, and in some respects superior to the other two solutions, costs less, will require less maintenance and considerably less hoistway space, this solution should be accepted as the final recommendation.

> **NOTE:** At this point, and before final plans and specifications are completed, a competent engineer should check the result, taking into consideration the local conditions, the characteristics of the building, its location with respect to horizontal transportation facilities, and the tempo of the tenants. Since it has not appeared practical to prepare simple curves to include all the benefits derived from Selectomatic-Automatic, with Automatic Traffic Pattern consideration should be given to further efficiencies resulting from its use. Some further modification of the elevator recommendation may be indicated. However, it is believed that the data presented will be of assistance to a person responsible for the general planning of a building.

D. APPLICATIONS

1. General. The information concerning traffic study provided in paragraph B, this section, page 28, is generally applicable to all types of buildings. There are, however, particular details which should be observed in each case.

2. *Office Buildings.*

a. EXPECTED POPULATION. Where it is not possible to know the expected population or density per floor, the following assumptions should be made:

(1) *Eighty* square feet per person on lower floors of single-occupancy buildings. On some floors the density may be as high as fifty square feet per person.

(2) *Ninety* square feet per person on lower floors of buildings in congested areas of large cities *(heavy traffic).*

(3) *One hundred* square feet per person on lower floors of buildings in business sections of average cities *(average traffic).*

(4) *One hundred ten* square feet per person on lower floors of buildings in business sections of small cities or outlying districts of larger cities *(light traffic).*

(5) For buildings of over twenty floors or where upper floors have smaller areas, add *ten* square feet per person for upper floors.

(6) For buildings of over thirty floors, add an additional *twenty-five* square feet per person in the tower section.

b. TRAFFIC FLOW. Where the maximum number of persons expected to arrive or depart in any five minutes is not known, the following assumptions should be made:

(1) *Light traffic*
12 percent of population.
(2) *Average traffic*
13 percent.
(3) *Heavy traffic*
14 percent for first 30 floors; 12 percent in tower section. (Requirements for single-occupancy buildings may be much greater.)

c. INTERVAL. In large cities maximum intervals are generally thirty seconds; for small buildings forty seconds may be satisfactory.

d. CONTROL. Basic type of control is Selectomatic-Automatic with Automatic Traffic Pattern. Signal control is satisfactory for smaller buildings with one or two elevators. Selective collective control is satisfactory for certain types of smaller buildings, particularly single-occupancy buildings, and where attendants are not necessary to direct and guide the passengers.

3. *Department Stores.*

a. SELECTION TABLE. Table VI provides a selection chart for department store elevators. As was previously stated, however, the round-trip time curves, figures 35 to 48 inclusive, should not be used in this application. Each installation should have its own calculations in this regard since there are so many variables.

b. ELECTRIC STAIRWAYS. In modern department stores electric stairways handle most of the traffic. Elevators are used as auxiliaries and therefore are not required to stop at all floors on every trip.

c. POPULATION. When accompanied by adequate electric stairways, only fifteen to twenty percent of the department store traffic should normally be considered in planning for elevator installations.

d. CONTROL. Basic type of control is Selectomatic-Automatic, with Automatic Traffic Pattern.

4. Apartment Houses.

a. SELECTION. Traffic studies may be made before elevators are recommended for an apartment house, or the selection may be determined by past practice in similar buildings, based on the number of bedrooms.

b. TRAFFIC STUDY. Apartment house traffic depends largely upon the class of tenant and location of the building with respect to the business center and schools. The heaviest traffic peak is the morning down-peak when approximately fifty percent of the population must be handled in one-and-a-half to two hours. Where the number of school children in the building is large, the after-school peak may be heavier than the morning peak. The evening peak to local amusements may be the heaviest.

c. PASSENGER-CARRYING CAPACITY. Due to the smaller and more extended peak in an apartment building, a five-minute carrying capacity of seven percent of the population is satisfactory.

d. INTERVAL. The interval may be much longer in apartment houses than would be acceptable elsewhere. Basically, if the population is adequately handled the interval may be comparatively long, perhaps twice that permitted in office buildings.

5. Hospitals.

a. TRAFFIC. The number of beds is the basis for calculating the probable traffic.

(1) *Vehicles.* Elevator installations for hospitals must take into consideration the numerous vehicles such as stretcher carts and beds, wheel chairs, linen carts, garbage trucks, laundry trucks, ice carts, formula trucks, and various portable apparatus to be transported.

(2) *Floor to Floor.* This type of traffic continues throughout the day.

(3) *Peaks.* Temporary passenger peaks occur at each change shift, at meal times, and at the close of visiting hours. Experience has shown that the passenger peak is approximately 240 passengers per hour and the vehicle peak is 29 vehicles per hour per 100 beds. For theoretical traffic calculations, a vehicle may be regarded as approximately 9 people.

b. BANKS. Where two or more elevators are required they should be grouped in a central location rather than located separately. The group has a much better interval and the short extra walk is usually less tiring than the longer wait for an elevator.

c. PASSENGER AND SERVICE ELEVATORS. In very large hospitals it is usually advisable to install a bank of passenger elevators and additional banks of service elevators to handle stretcher carts or beds, wheel chairs, etc. In such cases the passenger elevators should be selected as for office buildings.

d. HOSPITAL ELEVATORS. In small and medium size hospitals a separate bank of passenger elevators is not usually necessary or desirable. The passenger elevators should be of the hospital type so they can handle vehicles as well as passengers.

e. INTERVAL. Interval is important but it need not be as short as for office buildings. Since interfloor traffic is primarily hospital personnel, elevators should be arranged so that employees' time will not be waisted in long waits for elevators or so that they will not have to use the stairs because of inadequate elevator service. Generally, intervals should not be longer than one minute.

f. ROUND-TRIP TIME. Passenger traffic is two-way. However, up-and-down peaks are unlikely to occur simultaneously. In figuring the round-trip time, therefore, a full load of passengers should be figured in one direction and one half the number in the opposite direction. The sum of the traffic in both directions is 240 per 100 beds, previously referred to, plus the adjustment for wheeled vehicles.

g. CONTROL. The basic type of control for hospitals is two-button selective collective.

Budget Price Data

A. GENERAL

NOTE: Prices given in this section are for use only as a guide in preparing a budget and should not be regarded as an actual price quotation.

1. In selecting passenger elevators for a particular installation, one of the considerations is the amount of investment involved.

2. The basic information for calculating budget figures for standard passenger elevator equipment in this Guide is presented in figures 39 and 40.

B. EXAMPLE

The following typical examples are based on the calculations in Section 4, for a 21-floor office building, control, SMA-ATR with traffic sentinel.

1. All Elevators Local

Eight 3000-pound, 700 fpm, Variable Voltage, Gearless elevators.

a. The curves in figure 40 are for variable voltage gearless equipment. The 3000-pound, full-line curve is to be read since office building elevators are of the General Purpose category. The vertical axis is 700 feet per minute.

b. CALCULATIONS

Basic cost for one 3000-pound, 700 fpm elevator for 10 floors	$ 83,600.00
For each additional local floor, $1700.00 x 11	18,700.00
Total for one elevator	$102,300.00
Total for 8 elevators	$818,400.00

2. All Elevators Local

Seven 4000-pound, 700 fpm, Variable Voltage, Gearless elevators.

a. Use full-line curve in figure 40, for 4000-pound capacity. The vertical axis is 700 fpm.

b. CALCULATIONS

Basic cost for one 4000-pound, 700 fpm elevator for 10 floors	$ 87,700.00
For each additional local floor, $1700.00 x 11 floors	18,700.00
Total for one elevator	$106,400.00
Total for 7 elevators	$744,800.00

3. Local and Express Elevators

Four 2500-pound, 700 fpm, Variable Voltage, Gearless elevators (serving floors 1 to to 12).

Four 2500-pound, 700 fpm, Variable Voltage, Gearless elevators (serving floors 1—13 to 21).

a. Use full-line curve in figure 40, for 2500-pound capacity. The vertical axis is 700 fpm.

b. CALCULATIONS *(for local elevators)*

Basic cost for one 2500-pound, 700 fpm elevator for 10 floors	$ 81,400.00
For each additional local floor, $1700.00 x 2	3,400.00
Total for one elevator	84,800.00
Total for 4 elevators	$339,200.00

c. CALCULATIONS *(for express elevators)*

Basic cost for one 2500-pound, 700 fpm elevator for 10 floors	$ 81,400.00
For each express floor $560.00 x 11	6,160.00
Total for one elevator	$ 87,560.00
Total for four elevators	$350,240.00

d. CALCULATIONS *(for local and express elevators)*

Total cost for four local elevators	$339,200.00
Total cost for four express elevators	350,240.00
Total cost for bank of four local and four express elevators	$689,440.00

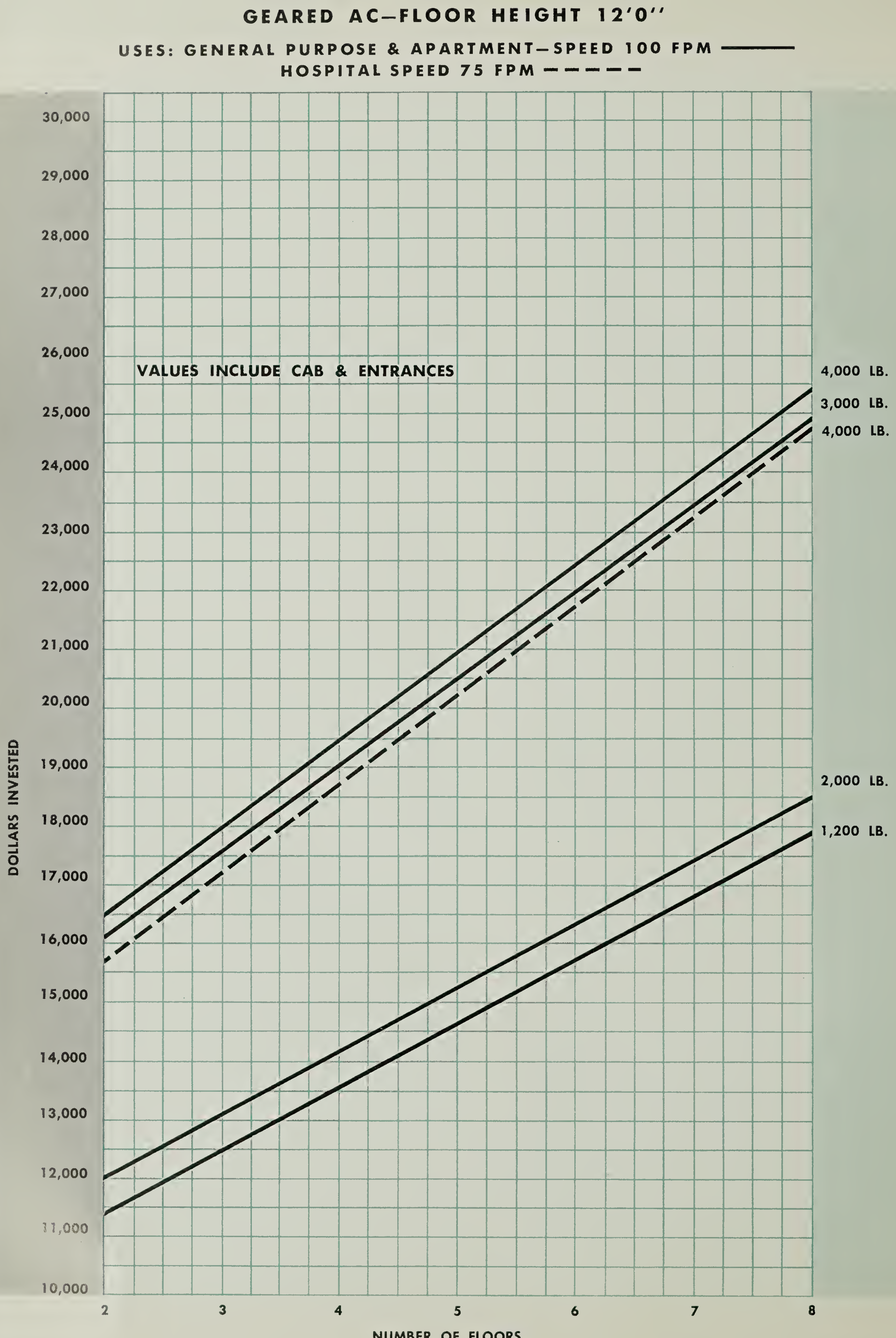
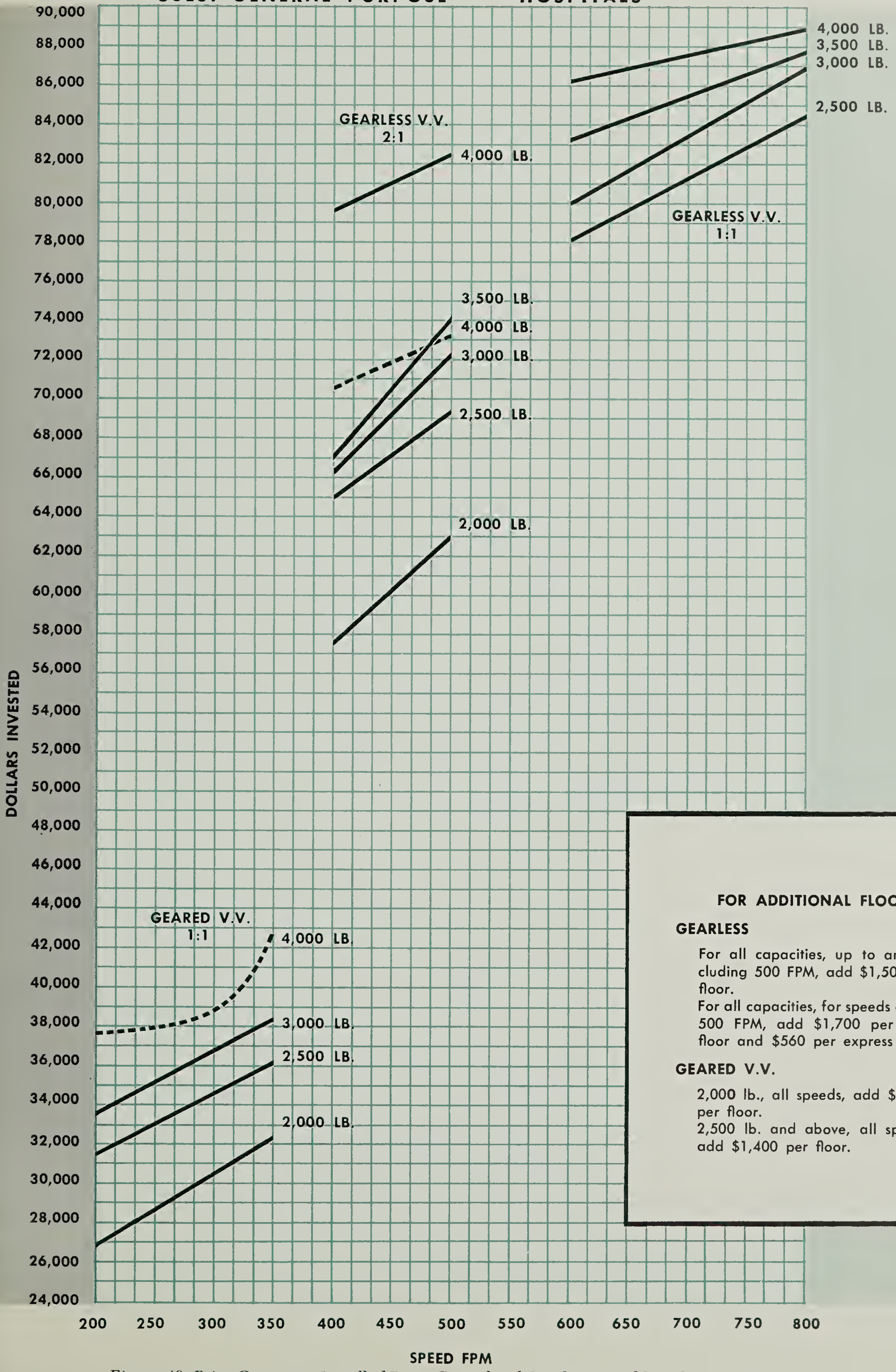


Figure 39. Price Curves on Installed Basis, Geared A-C Rheostatic Elevators

GEARLESS (SM-AUTO-ATP) GEARED VV 1:1

CURVES BASED ON 10 FLOORS FOR GEARLESS, 6 FLOORS FOR GEARED,
FLOOR HEIGHT 12'0''

USES: GENERAL PURPOSE ——— HOSPITALS – – – – –



FOR ADDITIONAL FLOORS

GEARLESS

For all capacities, up to and including 500 FPM, add $1,500 per floor.

For all capacities, for speeds above 500 FPM, add $1,700 per local floor and $560 per express floor.

GEARED V.V.

2,000 lb., all speeds, add $1,250 per floor.

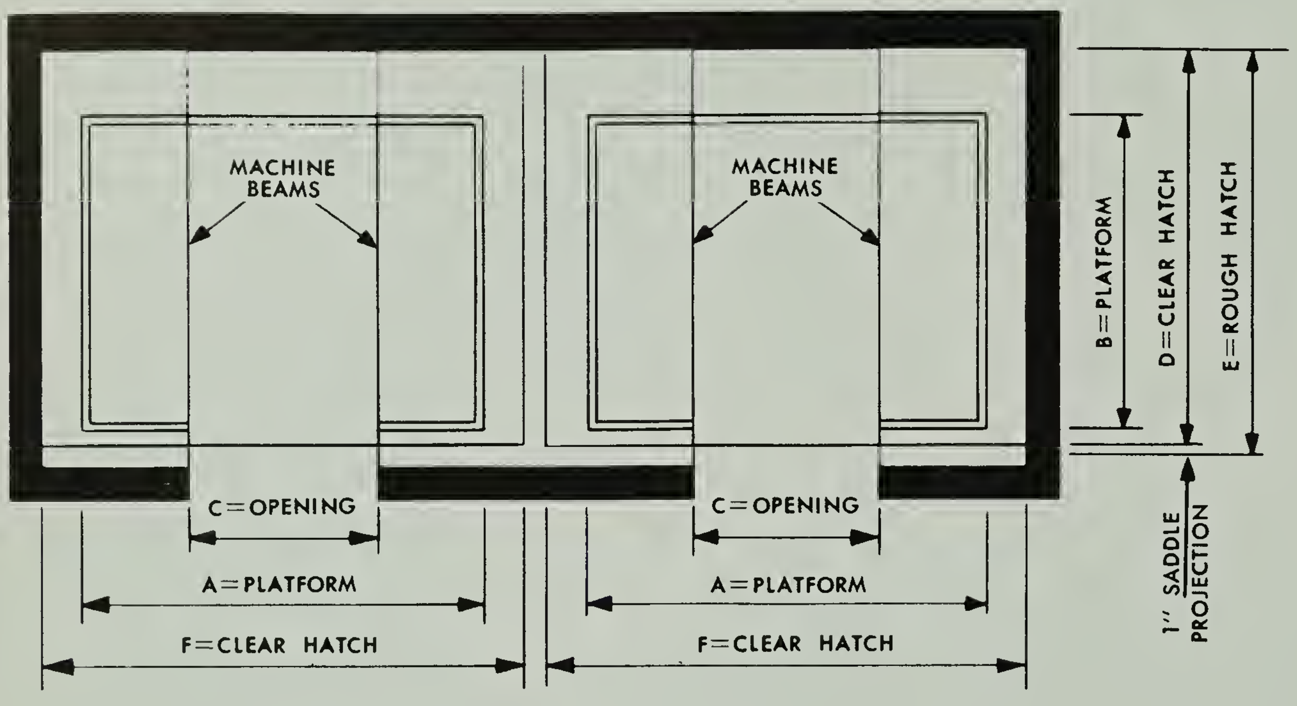
2,500 lb. and above, all speeds, add $1,400 per floor.

Figure 40. Price Curves on Installed Basis, Geared and Gearless Variable Voltage Elevators

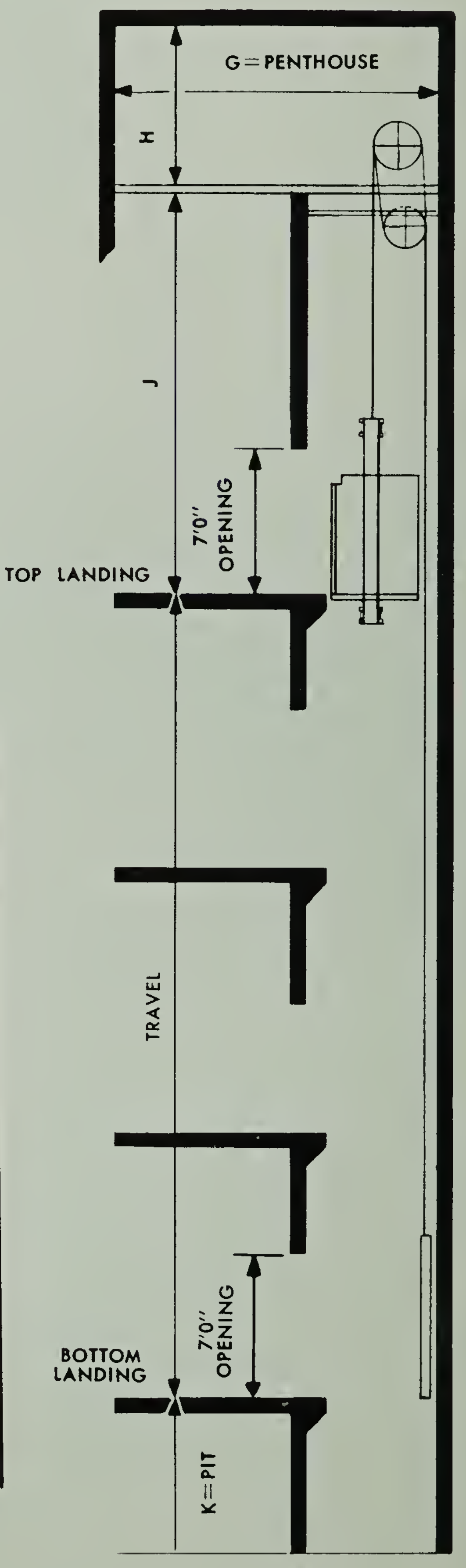
Layouts

GENERAL PURPOSE GEARLESS — VARIABLE VOLTAGE CONTROL

Capacity — 2000 to 4000 lbs. • Car Speed — 400 to 500 fpm **ROPING 2:1**



PLAN



ELEVATION

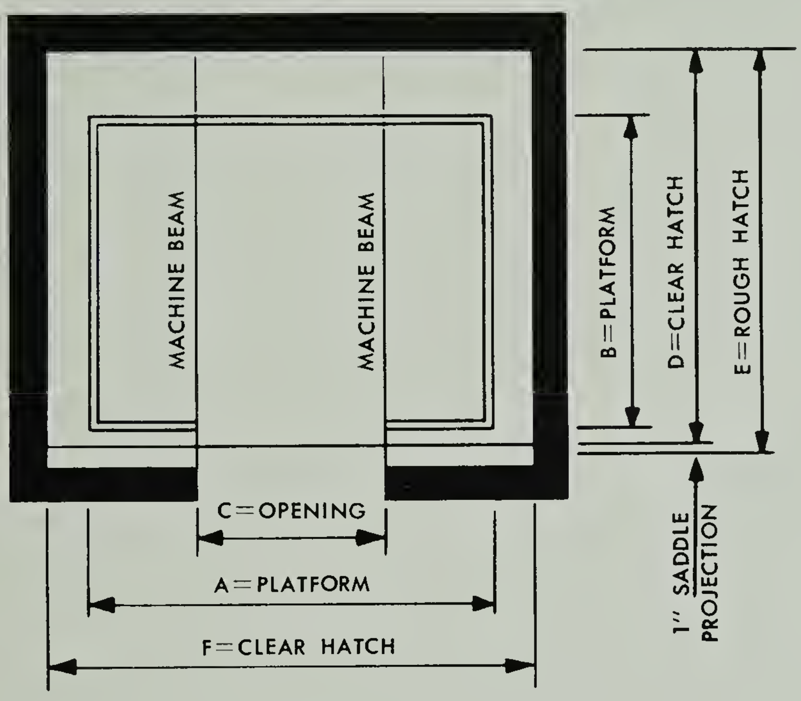
Capacity in lbs.	Speed FPM	Dimensions									
		A	B	C	D	E	F	G	H	J	K
2000	400 500	6'4"	4'5"	3'0"	5'9½"	5'10½"	7'8"	14'6"	8'6"	24'7" 26'1"	7'9" 8'9"
2500	500	7'0"	5'0"	3'6"	6'4½"	6'5½"	8'4"	23'0"	8'6"	26'1"	10'3"
3000	500	7'0"	5'6"	3'6"	6'10½"	6'11½"	8'4"	23'0"	8'6"	26'1"	10'3"
3500	500	7'0"	6'2"	3'6"	7'6½"	7'7½"	8'4"	23'0"	8'6"	26'1"	10'3"
4000	500	7'6"	6'6"	3'10"	7'10½"	7'11½"	8'10"	23'0"	9'6"	26'1"	10'3"

NOTE: The dimensions given in these layouts are based on National Elevator Manufacturers Industry (N.E.M.I.) Standards, as noted. For special conditions, consult your nearest Westinghouse Elevator Division Office listed on back page.

GENERAL PURPOSE GEARED — A-C AND VARIABLE VOLTAGE CONTROL

Capacity — 2000 to 4000 lbs. • Car Speed — 100 to 350 fpm

ROPING 1:1



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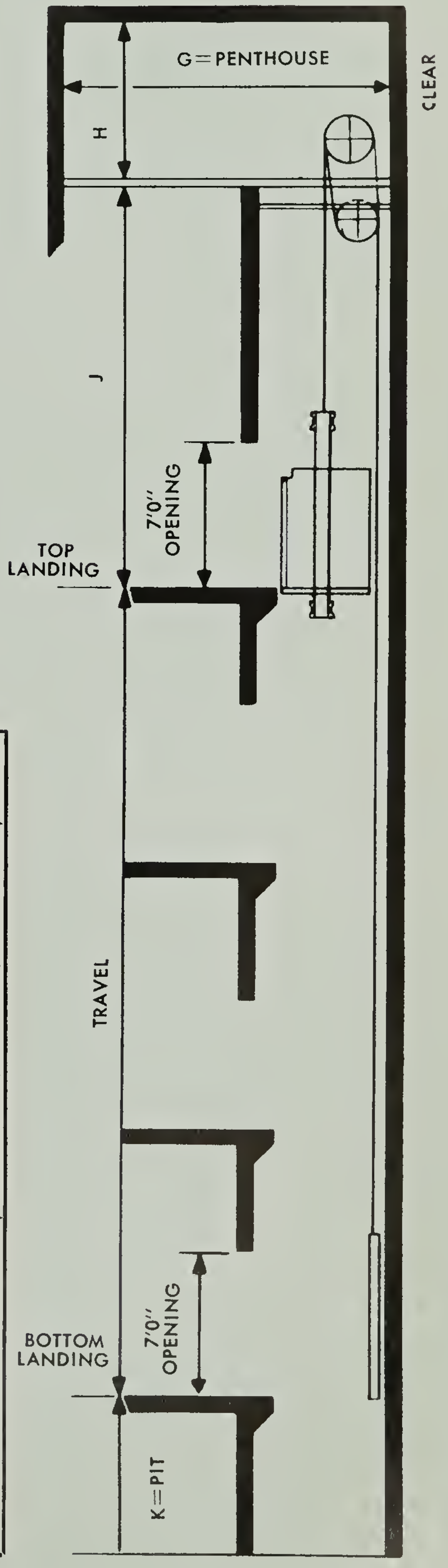
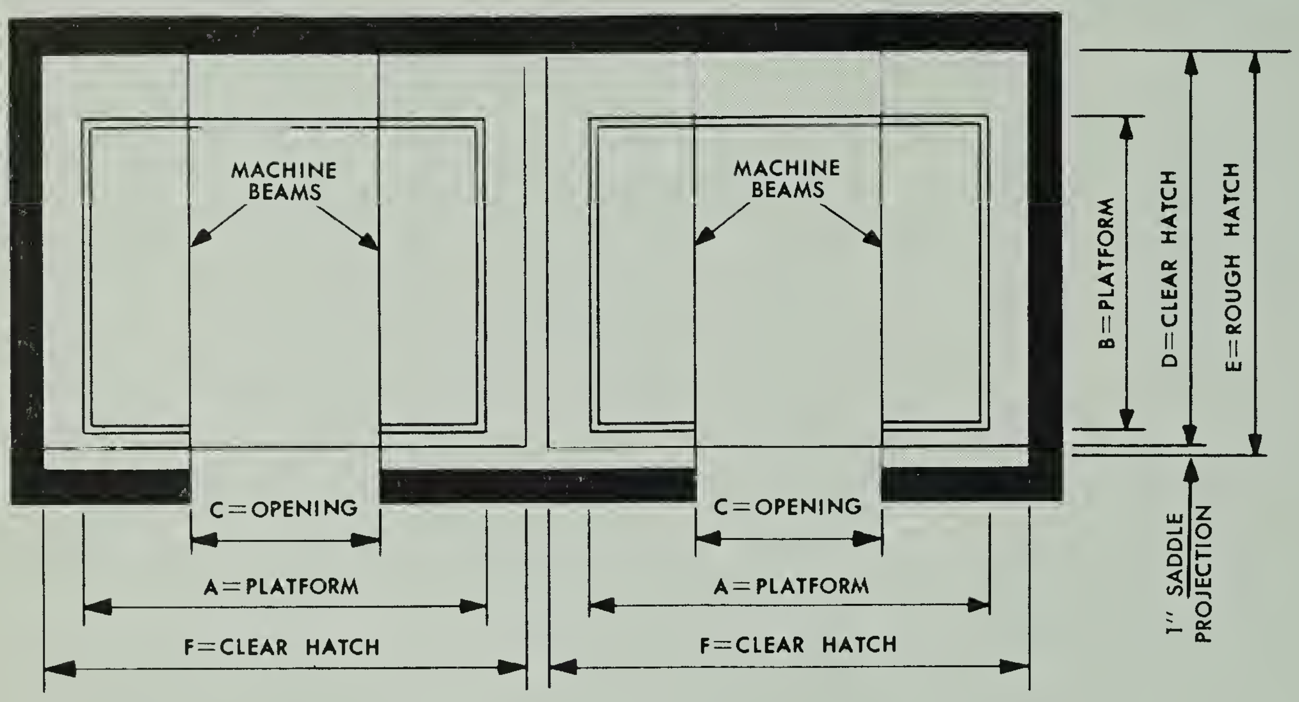


ELEVATION

Capacity in lbs.	Speed FPM	Dimensions									
		A	B	C	D	E	F	G	H	J	K
2000	*100 200 250 300	6'4"	4'5"	3'0"	5'7¼"	5'8¼"	7'8"	11'0" 11'6" 11'6" 11'6"	7'6"	16'9" 17'0" 17'6" 17'6"	4'6" 4'10" 6'8" 6'8"
2500	*100 200 350	7'0"	5'0"	3'6"	6'2¼"	6'3¼"	8'4"	11'0" 11'6" 11'6"	7'6"	16'9" 17'0" 18'3"	4'7" 5'2" 7'8"
3000	*100 200 300 350	7'0"	5'6"	3'6"	6'8¼"	6'9¼"	8'4"	11'0" 12'0" 12'0" 12'0"	7'6"	16'9" 17'0" 17'6" 18'3"	4'9" 5'2" 6'8" 7'8"
3500	*100 250 300 350	7'0"	6'2"	3'6"	7'4¼"	7'5¼"	8'4"	11'6" 12'0" 13'6" 13'6"		16'9" 17'6" 17'6" 18'3"	4'9" 6'9" 6'9" 7'8"
4000	*100 200 250 350	7'6"	6'6"	3'10"	7'8"	7'9"	8'10"	11'6" 12'0" 13'6" 14'0"	7'6"	17'3" 17'6" 19'6" 19'6"	4'6" 5'4" 5'4" 6'4"
*AC Control											

GENERAL PURPOSE GEARLESS — VARIABLE VOLTAGE CONTROL

Capacity — 2500 to 4000 lbs. • Car Speed — 700 to 1000 fpm ROPING 1:1



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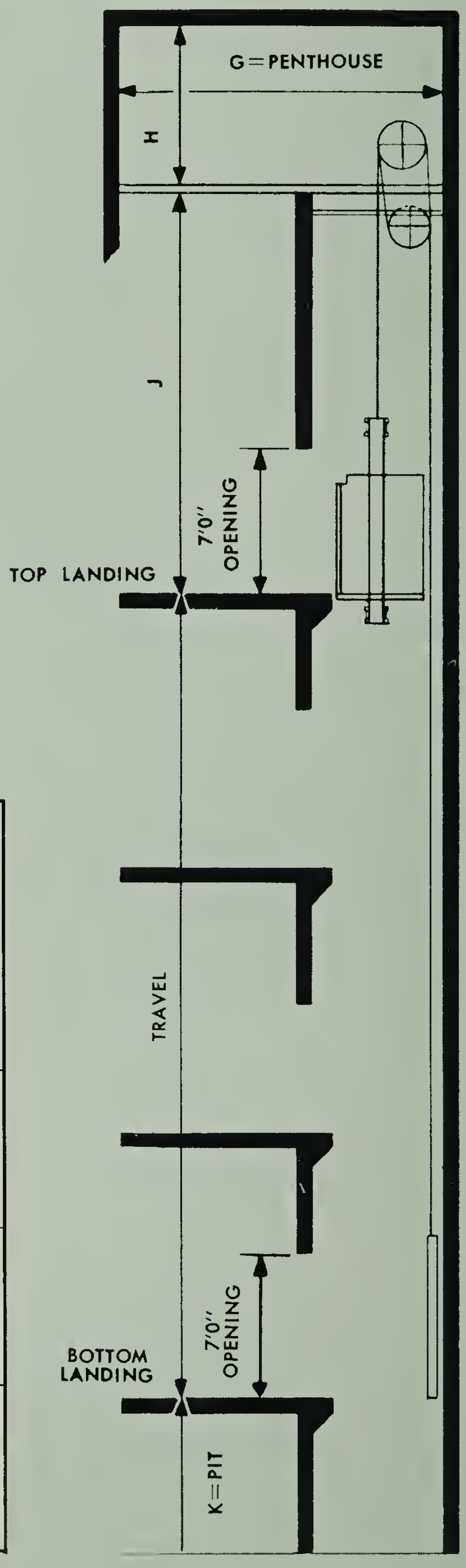


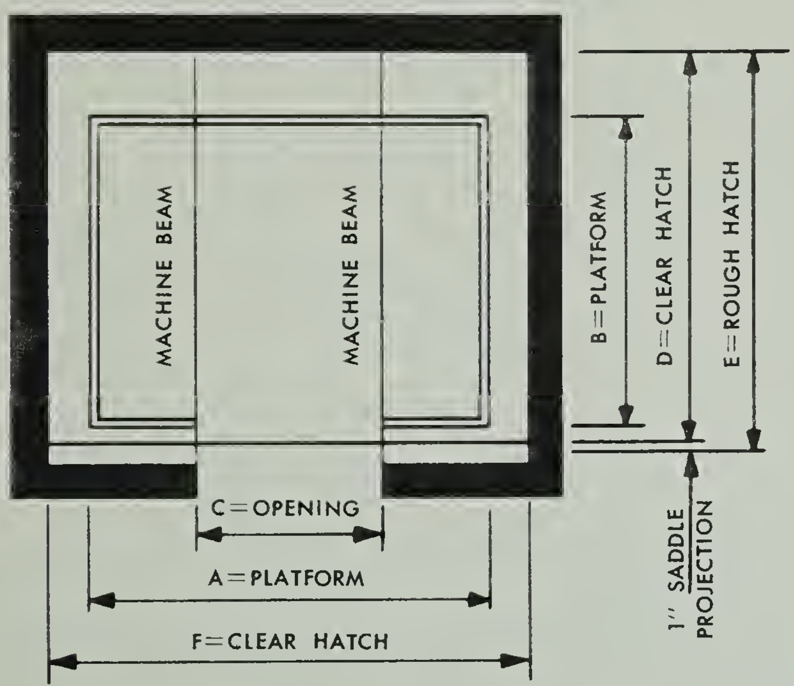
ELEVATION

Capacity in lbs.	Speed FPM	Dimensions									
		A	B	C	D	E	F	G	H	J	K
2500	700 800	7′0″	5′0″	3′6″	6′4½″	6′5½″	8′5″	23′0″	9′6″ 10′6″	27′6″ 29′10″	12′6″
3000	700 800 1000	7′0″	5′6″	3′6″	6′10½″	6′11½″	8′5″	23′0″	9′6″ 10′6″ 10′6″	27′6″ 29′10″ 29′10″	12′6″
3500	700 800 1000	7′0″	6′2″	3′6″	7′6½″	7′7½″	8′5″	23′0″ 24′0″ 24′0″	10′6″	27′6″ 29′10″ 29′10″	13′0″
4000	700 800 1000	7′6″	6′6″	3′10″	7′10½″	7′11½″	8′11″	23′0″ 24′0″ 24′0″	10′6″	27′6″ 29′10″ 29′10″	13′0″

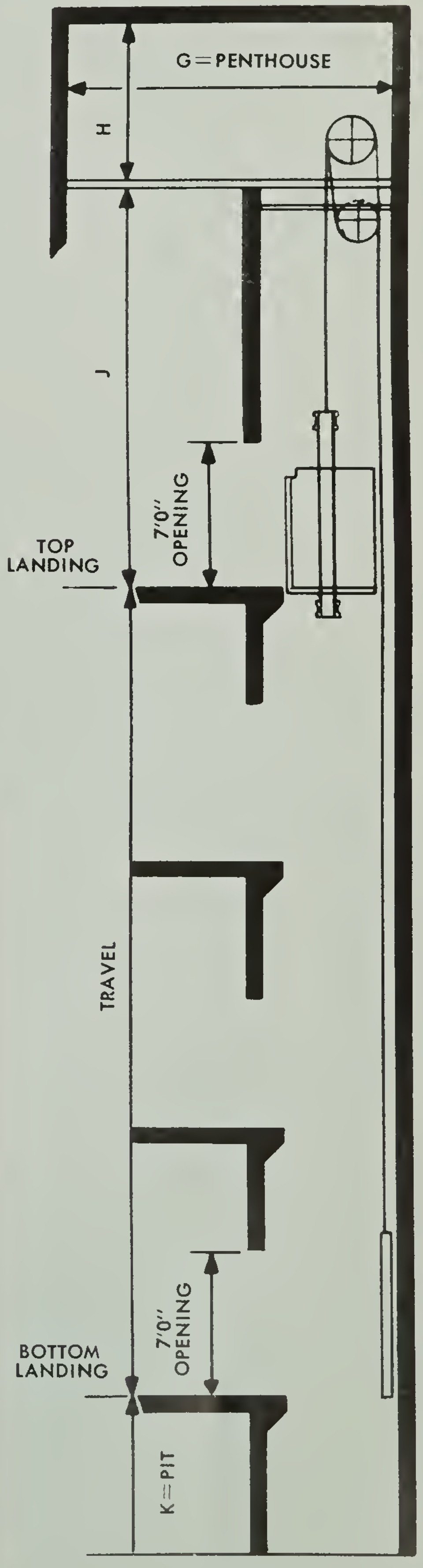
APARTMENT HOUSE GEARED—A-C AND VARIABLE VOLTAGE CONTROL

Capacity — 1200 to 2500 lbs. • Car Speed — 100 to 300 fpm

ROPING 1:1



PLAN



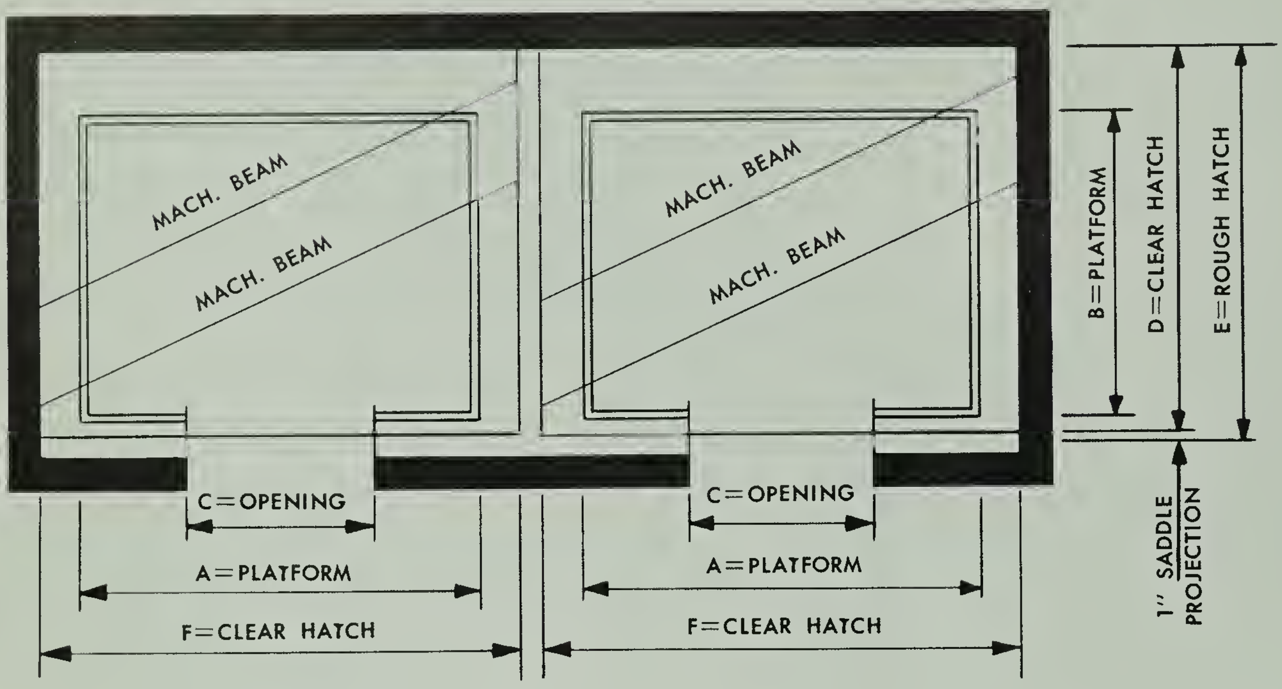
ELEVATION

Capacity in lbs.	Speed FPM	Dimensions									
		A	B	C	D	E	F	G	H	J	K
1200	100	5'0"	4'0"	** 2'8"	5'2"	5'4"	6'4"	9'6"	7'6"	16'9"	4'6"
2000	*100 250	6'4"	4'5"	*** 3'0"	5'7"	5'8¼"	7'8"	11'0" 11'6"	7'6"	16'9" 17'6"	4'6" 6'8"
2500	200 350	7'0"	5'0"	3'6"	6'2"	6'3¼"	8'4"	11'6"	7'6"	17'0" 18'3"	5'2" 7'8"

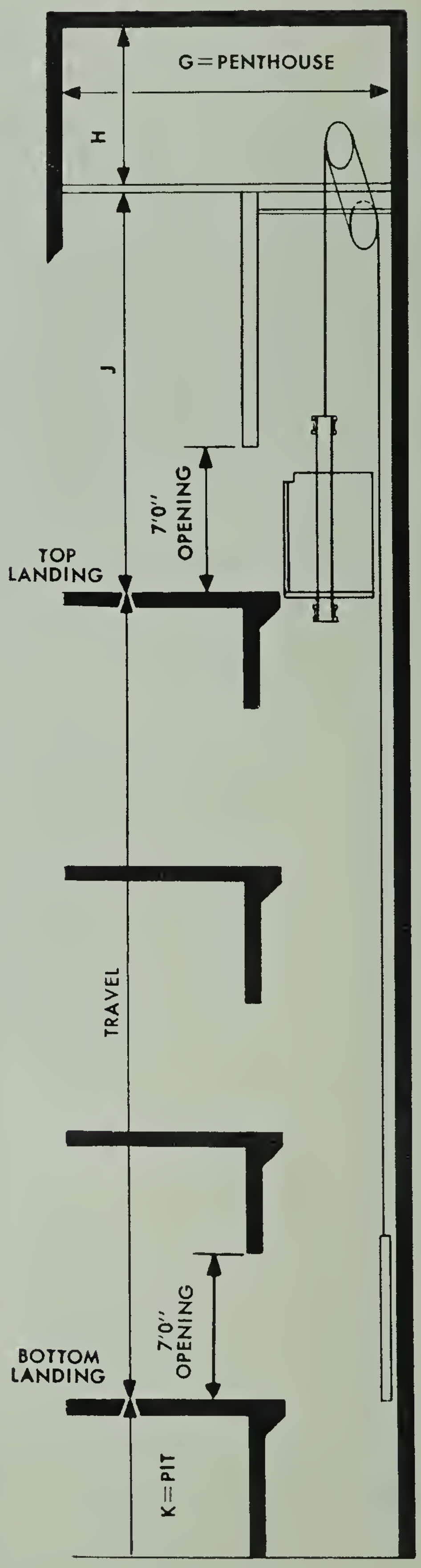
* AC Control
** Swing Doors on Hatch 2'6"
*** Swing Doors on Hatch 2'10"

HOSPITAL GEARED — A-C AND VARIABLE VOLTAGE CONTROL

Capacity — 3500 to 4000 lbs. • Car Speed — 75 to 350 fpm ROPING 1:1



PLAN



ELEVATION

Capacity in lbs.	Speed FPM	Dimensions									
		A	B	C	D	E	F	G	H	J	K
3500	* 75	5'4"	8'0"	3'8"	8'4"	8'5"	7'3"	11'9"	7'6"	16'9"	4'6"
	*100							11'9"		16'9"	4'9"
	100							13'0"		16'9"	4'9"
	300							13'6"		17'6"	6'9"
	350							13'8"		18'3"	7'8"
4000	* 75	5'8"	8'4"	3'10"	8'8"	8'9"	7'8"	11'9"	7'6"	16'2"	4'6"
	*100							11'9"		16'9"	4'9"
	100							13'0"		16'9"	4'9"
	250							13'6"		17'6"	6'8"
	350							13'8"		18'3"	7'8"

* AC Control

Installations

Throughout the nation, Westinghouse passenger elevators have proved their ability to meet every vertical transportation problem.

In every type of building—office building, hotel, store, apartment house, hospital, bank, industrial plant—Westinghouse passenger elevators provide the required service by meeting every traffic condition.

Modernization

All of the newest equipment and accumulated experience which goes into the planning of a Westinghouse new elevator installation can be used to the fullest advantage in modernizing equipment that may have outlived its peak efficiency. Outmoded Vertical Transportation Service can, and should, be modernized. Westinghouse has made a specialty of transforming existing equipment into modern, swift, smooth operatorless, passenger-pleasing traffic carriers.

If a building is ten, fifteen, twenty or more years old, it may be severely handicapped today, unless its facilities have kept pace with the newest developments in this important phase of public service.

Vertical Transportation Service in old buildings can be as up-to-date as the most modern buildings still in the blueprint stage.

The foregoing study of the most up-to-date systems and equipment is presented for your consideration by Westinghouse to demonstrate how, old or new, your building can have all the benefits of MODERN VERTICAL TRANSPORTATION SYSTEM.

Protective Maintenance

A Westinghouse Protective Maintenance Agreement will relieve the owner of the responsibilities of vertical transportation problems and worries. Under this contract Westinghouse agrees to take all responsibility for proper operating conditions of the passenger elevators. The contract provides for labor, materials, and necessary parts required to insure operating efficiency.

Here are the 10 BIG ADVANTAGES of Westinghouse Protective Maintenance!

1. **Maximum Safety and Smooth Operation**
2. **Greater Tenant Satisfaction**
3. **Increased All-round Economy**
4. **No Unexpected Large Repair Bills**
5. **Fewer Shut Downs . . . Less Time Out**
6. **24-Hour Service at All Times**
7. **Longer Elevator Life**
8. **Greater Elevator Efficiency**
9. **Genuine Westinghouse Parts**
10. **Complete Westinghouse Facilities**

Westinghouse Protective Maintenance is paid for on a monthly basis, thus permitting accurate budgeting of all elevator maintenance costs on a predetermined, fixed charge basis. The clearly worded contract covers in detail the responsibilities Westinghouse will assume, the work it will do, and the service the company will give.

Thousands of satisfied building managers throughout the country attest to the value of this maintenance plan. By turning over the safekeeping of your passenger elevators to Westinghouse you are assured of positive protection and trouble-free operation.

ELEVATOR DIVISION

WESTINGHOUSE ELECTRIC CORPORATION • JERSEY CITY 4, N. J.

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